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THE IMPACT OF THE GENERATION MIX ON ELECTRICITY MARKET PRICES: A COMPARATIVE ANALYSIS AT EUROPEAN LEVEL

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List of abbreviations

AC:	Alternating current
AELEC:	"*Asociación Española de la Industria Eléctrica",* i.e. Spanish Electrical Industry Association
AIC:	Akaike Information Criterion
AU:	"*Acquirente Unico",* i.e. Single Buyer
CDE:	"*Consegna Derivati Energia"*
CNE:	*"Comisión Nacional de Energia",* i.e. National Energy Commission
CNMC:	"*Comisión Nacional de los Mercados y la Competencia",* i.e. National Commission for Markets and Competition
D:	Day D
DC:	Direct Current
DSO:	Distribution System Operator
EEX:	European Energy Exchange
ENEA:	"*Agenzia Nazionale per le nuove tecnologie, l'energia e lo sviluppo económico sostenibile",* i.e. National Agency for new technologies, energy and sustainable economic development
ENEL:	"*Ente Nazionale per l'Energia Elettrica"*
ENTSO-E:	European Network of Transmission System Operators for Electricity
ESIOS:	"*Sistema de Información del Operador del Sistema (Red Eléctrica de España)",* i.e. Information System of Operator
EU:	European Union
GME:	"*Gestore del Mercato Elettrico",* i.e. Electricity Market Operator
GRNT:	"*Gestore della Rete di Trasmissione Nazionale*", i.e. National Transmission Grid Operator
GSE:	*"Gestore dei Servici Energetici",* i.e Energy Services Manager
IPEX:	Italian Power Exchange
JB:	Jarque Bera
MGP:	"*Mercato del Giorno Prima", i.e*. Day-ahead Market
MI:	"*Mercato Infragiornaliero", i.e. Infraday Market*
MIBEL:	"*Mercado Ibérico de Electricidad",* i.e. Iberian Electricity Market
MIBGAS:	"*Mercado Ibérico del Gas",* i.e. Iberian Gas Market
MLE:	"*Mercado Legal Estable",* i.e. Stable Legal Market
MO:	Market Operator
MPE:	"*Mercato Elettrico a Pronti"*
MSD:	"*Mercato del Servizio di Dispacciamento",* i.e. Ancillary Services Market
MTE:	"*Mercato electtrico a Termine dell'energia elettrica"*
NREAP:	National Renewable Energy Action Plan
OLS:	Ordinary Least Squares
OMIE:	"*Operador del Mercado Ibérico de Energía – Polo Español",* i.e. Spanish Energy Market Operator.
OMIP:	*"Operador del Mercado Ibérico de Energía- Polo Portugués",* i.e. Portuguese Energy Market Operator.
OTC:	Over The Counter
PEN:	"*Plan Energético Nacional",* i.e. National Energy Plan

PNIEC:	"*Piano Nazionale Integrato per l'Energia e il Clima",* i.e. Integrated National Energy and Climate Plan
PUN:	"*Prezzo Unico Nazionale",* i.e. Single National Price
PV:	Photovoltaics
REE:	"*Red Eléctrica Española",* i.e. Spanish Electricity Network
RES:	Renewable Energy Sources
SMP:	Spanish Market Price
TIDME	"*Testo Integrato della Disciplina del Mercato Elettrico",* i.e. Integrated Text of the Electricity Market Regulations
TSO:	Transmission System Operator
UNESA:	"*Asociación Española de la Industria Eléctrica", i.e. Spanish Electrical Industry Association*
ZMP:	Zonal Market Price

List of symbols

β_0:	Regression's constant
β_1:	Regression's coefficient for Load
β_2:	Regression's coefficient for RES
β_3:	Regression's coefficient for Solar
β_4:	Regression's coefficient for Wind
β_5:	Regression's coefficient for PGAS
β_6:	Regression's coefficient for Hydro
ρ:	Coefficient of AR(1)
ADF:	Augmented Dickey Fuller
AR(1):	First order autoregressive process
b_1:	Sample skewness of Jarque Bera test
b_2:	Kurtosis coefficient of Jarque Bera test
BP:	Breusch Pagan
D:	Vector of dummies
DW:	Durbin Watson statistic after applying serial correlation on the residuals
DW_0:	Durbin Watson statistic before applying serial correlation on the residuals
E:	Mean
Ɛ:	Error term of a regression
HYDRO:	Megawatts of hydroelectric energy from reservoir
LOAD:	Total load in megawatts
n:	Size of the sample
P:	Price
PGAS:	Gas price in €/MWh
PP:	Philips-Perron
Q:	Quantity in megawatts
R^2:	Regression's correlation coefficient
r_s:	Spearman's coefficient
SOLAR:	Megawatts of solar energy
WIND:	Megawatts of wind energy
X:	Independent variable of a regression
Y:	Dependent variable of a regression
σ:	Variance

ABSTRACT

The goal of this thesis is to investigate the impact of non-programmable renewable energy generation mix on Italian and Spanish electricity markets by studying electricity price in the spot electricity market. Specifically, to investigate whether different energy sources have a different impact on the price, whether and or how much this is varying from different market zones and whether the impact is on general, daily-basis or maybe rather on an hourly basis.

To detect the impact on electricity prices, it is followed a consolidated methodology adopted by Clò et al. [1] and developed an empirical analysis for Italy's commercial markets and for the whole Spanish market by using a multivariate regression. It is considered daily averaged data for the renewable generation mix (specifically solar and wind) and spot electricity price from the respective day-ahead markets for the whole year 2018. As a secondary studio the impact on electricity prices in Italy is analysed by using hourly data.

The results obtained support the hypothesis that rising zonal loads tend in general to raise zonal market prices based on the data from 2018. The intensity of this effect is pronounced with varying intensity. In Italy the lowest effect is in the North, with an impact of 1.19 €/MWh increase for each 1000 MWh of demand. The highest effect is found in the islands, reaching a value of 25.11 €/MWh in Sicily. In Spain, there is a low impact of load, with a value of only 0.045 €/MWh. It is interesting to stress how the impacts of photovoltaics and wind vary across Italian zone. While both prove to have in general a decreasing impact, on the electricity spot price, wind is the main driver of the electricity price reduction in the southern zonal areas whereas solar has a more significant decreasing impact on the northern zone prices. Eventually, Central North is the zone with the highest impact of both renewable sources. In Spain, no evidence is found for photovoltaics for electricity price reduction. But, on the other hand, an increase of 1 GWh of wind decreases the Spanish electricity price by 1.42 €/MWh. The results obtained also show for both Italy and Spain the assumption of high correlation between the price of gas and electricity: an increase of 1 €/MWh of gas price causes statistically an electricity price increase between 0.90 €/MWh and 1.73 €/MWh in Italy (depending on the zone) as well as an increase of 1.76 €/MWh in Spain.

Compared to the daily data case, results of the secondary analysis show that solar comes out significant in all zones of Italy. Energy from solar panels is obtained only a few hours a day, therefore it turns out that the impact seems to be stronger on an hourly basis. However, wind has rather a daily impact, being wind generation more constant from day to day also not having such a plausible difference between hours as solar.

1. INTRODUCTION

The layout of global energy systems has significantly changed over the past decades, in particular considering the last 20 years of innovation, efficiency improvement and economic development. Conventional power sources have been started to be substituted with renewable resources, in the so-called *decarbonization* of the planet, in order to cease greenhouse gases' emissions into the atmosphere.

This transition has heavily affected electricity generation, distribution and consumption, since many treaties and policies have been implemented to effectively realize this energy turnaround. Energy markets have not escaped from the effects of the large penetration of renewable energy sources into the energy generation mix, especially in Italy where energy production from renewable sources grew rapidly and consistently from the last years of 2000s reaching more than 100 TWh in 2017. This is an increase by 49.5 % in ten years, compared to 2007 where renewable energy production was 56.55 TWh [2]. Theoretically, a larger penetration of RES should reduce energy prices in day-ahead markets given the lower marginal prices of renewable sources with respect to conventional fossil fuels, like coal, oil and natural gas. The question is however whether this can be proved and, if yes, quantified by actual market data.

The aim of this thesis is therefore to investigate the impact of renewable energy sources (specifically wind and solar) on electricity spot prices of two different electricity markets, the Italian and Spanish electricity market. Specifically, to investigate whether different sources have a different impact on the price, whether and or how much this is varying from different market zones and whether the impact is on general, daily-basis or maybe rather on an hourly basis.

To carry out this project, this thesis followed the well acknowledged study done by Clò et al. [1] and developed an empirical analysis using an autoregressive model. Explanatory variables included are the generation of non-programmable renewable energy sources [MW], power load [MW] and gas price [€/MWh] used to study their weights on spot prices as the dependent variable. The data used, for the spot market, has been selected and gotten from the respective national electricity market operators of Italy (GME) and Spain (OMIE) [3][4]. The data for the generation mix on the other hand has been provided by the European Network of Transmission System Operators for Electricity (ENTSO-E) [5]. The period of analysis is the whole year 2018 from January 1st until December 31st, taking into account any time of day for Spain and for each of the 6 commercial zones in which Italian electricity market is divided.

The work is organized as follows: in chapter 2 is presented the history of the Italian and Spanish market liberalization, that is, thanks to which policies both current markets structures have been reached. At the end of the chapter is also reported, for both countries, an explanation of the statistical data on the growth of renewable generation. Next, chapter 3 shows a brief overview of the current market structure for both national electricity systems. It is described the structure of Day-Ahead Market and Ancillary Services Market in Italy as well as the wholesale and retail market for Spain. Finally, in the following chapters are focused on the analysis. It is explained in detail the data and methodology used as well as the interpretation and comparison of the results obtained in the analysis.

2. Background: Electricity market developments

2.1. The Italian market developments and liberalization

Electricity industry started at the end of the 19th century when local suppliers produced electricity for consumers near the production site, public illumination, and transportation. The first European electricity plant dates back to 1883, built in Milan by Edison's company. It was a long period without a great innovation in market structure. It was segmented and unsuitable for satisfying consumption's increase mainly due to problems with power lines and, among other things, due to supply's discontinuity, with the result of a poor quality service. Therefore, a legislative intervention was necessary. In Italy nationalization arrived in the 1960s at the height of the economic boom, when politicians realized that electricity could be a great deal for an energy-consuming country like Italy. Already after the Second World War there was some legislative proposal but only, in 1962, a resolution come about: Law n. 1643 of December 6, 1962, also known as the Nationalization Law, was published [6]. With this regulation was established the "*Ente Nazionale per l'Energia Elettrica*" – ENEL (National Electricity Authority), a public legal entity subject to the supervision of the Minister for Industry and Business *"to which is reserved, on the national territory, the task production, import and export, transport, transformation, distribution and sale of electricity from any type of source produced […]"*[6]. In addition it was assigned to the new company the management of all existing companies and activities in the electricity supply chain. Doing so it was created a situation of state monopoly, with the aim of "*ensuring, with minimum management costs, an electricity's availability in terms of quantity and price adequate to the needs of a balanced economic development in the country"* [6]. Thanks to the monopoly it was possible to achieve objectives otherwise impossible, as the almost complete electrification of the country together to the harmonization of the cost of electricity.

By the early 1990s, Italy's electrical unification was already achieved. The main objectives of the Nationalization Law had been achieved, whereby the monopoly had exhausted its function and was time to move to the free market competition. More interest in renewable energy sources (RES) was taken by the government and the public because of environmental and climate preoccupations, together with the initiatives and the directives of the European Union: the commitment to double by 2010 the share of RES from the level in 1990 (from 7 % to 14 % of generation), in parallel with the doubling at the EU level.

The first important act of the government concerning RES was Law No. 308 of 1982 [7]. This law, in addition to imposing norms limiting energy consumption in production processes and establishing incentives for energy efficiency, dealt with the promotion of RES. This law introduced the first, embryonic regulation of renewable energy in Italy and had some innovative characteristics with respect to the energy situation of the time: first, it established an exception to the situation of monopoly in electricity production retained until then by ENEL, by allowing private generating plants based on RES with generation capacity up to 3 MWe; Second, it declared RES plants to be of ''public utility'', thus giving them a preferential route to obtaining construction authorisation and installation permits. Third, it introduced compulsory homologation of plants and devices for RES. Fourth, it used a provision from the Constitution of the Italian Republic to delegate some power (limited and specified) to the regional governments in the sub-sector of RES (as well as in energy efficiency). Also it introduced substantial incentives for RES, for applications in the building sector, in industry and in agriculture, ranging from 30 to 50 % of the capital costs and even up to 80 % in the case of PV.

The start toward full market liberalization occurred with Law n. 9/91 of January 9, 1991 [8]. This law eliminated the 3MW limit and made available funding for the construction of new plants. Regarding "traditional" sources, the regulation redefined the concept of self-consumption not only to the individual company, but also to all subjects of the same industrial group; the constraint on production for self-consumption was removed, allowing companies to sell more than 30% to Enel, with the possibility of selling the entire production to the public. The end of Enel's monopoly occurred in 1992, when it changed from a public body to a joint-stock company and became ENEL S.p.a.

Another step towards liberalization has been the establishment of a new body, the High Authority for Electrical Energy and Gas, created by Law 481 of 1995 [9]. The Authority determines regulations and criteria for the energy market, and it has a broad spectrum of related responsibilities. It responds to Parliament and is independent of the government, although it has to follow the decisions of the government concerning all the main energy policy decisions. It was only by the end of this transitory period that the concepts of energy market, liberalisation and privatisation started being introduced.

In November 1998, the Italian government organised a National Conference on Energy and Environment through the "National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA)". This conference came at the conclusion of a series of about 100 national and a few international meetings and workshops, which discussed all technical, economic, social, institutional and legislative aspects of the Italian energy system. The viewpoints of all stakeholders were collected, compared and discussed, in an unprecedented effort of public involvement. On the specific subject of RES, the conclusions of the Conference called for a doubling of their share in the production of electricity (see below), indicating that, in the context of the liberalisation of the electricity sector, market instruments should preferably be used to reach this goal. [10]

As in most other European countries, the second half of the 1990s has been characterised by the liberalisation of the energy market as well as by the privatisation of the former public monopolies for gas and electricity. This process has also involved the ''unbundling'' of energy companies, with separation between generation, transmission distribution and retail. In the same years, the European Union was working to establish a community approach to the electricity market, a process ended with Directive 96/92/EC [11]. The directive aimed to lead the market towards free competition through "*common standards for the generation, transmission and distribution of electricity. It defines the organizational and operating rules of the electricity sector, market access, the criteria and procedures to be applied […] as well as the management of the networks".* The rules envisaged increasing efficiency in all phases of the supply chain, while strengthening security of supply and competitiveness of the European economy, leaving states the choice of the most suitable regime for internal situations. The directive did not provide in any way exclusive rights for import, export, production, transmission and distribution of electricity, as had been the case of Italy. For this reason, the country found itself having to carefully study the changes and innovations to be introduced into the legislation.

Related to the Directive, in 1999, was published the Legislative Decree n. 79, known as *"Bersani Decree"* [12]. The formation process lasted three years and began with the establishment of the "*Carpi Commission*", made up of experts analysing the reform. The Commission's report showed the need to deeply change the structure of the electricity market in all its branches. The implementation of these points occurred by limiting the power of ENEL, establishing that by the beginning of 2003 an operator could not import or produce more than 50% of the total energy of the Italian market, thus forcing the institution to sell part of its market share. On the customer side, action was taken by dividing the market into captive and free market, with the aim of gradually reducing the former until reaching a situation of complete opening of the free market. Transmission remained an exclusive monopoly to the state through the creation of the "*Gestore della Rete di Trasmissione Nazionale"- GRNT* (National Transmission Grid Operator) now called Terna, who introduced the "*Acquirente Unico"* (Single Buyer), as guarantor of the production capacity of the captive market and the "*Gestore del Mercato Elettrico*" – GME (Electricity Market Manager). Distribution (as transmission) remained a regional monopoly, but operated through various private companies. It is only with the Bersani decree that, in Italy, we can talk about the liberalization of the electricity sector.

The liberalization process continued for several years with continuous regulatory developments. Only in 2007 Italy arrived at the complete liberalization with the transformation into Law of the Decree n. 73 of June 18, 2007 [13]. This decree determinates the legal unbundling between distribution companies and energy sale companies. They need to be legally unbundled by being separate companies (with different management, accounts etc.), but they can still be owned by the same "mother company". There are different levels of unbundling, legal unbundling being the less stringent one, ownership unbundling the most stringent one. The later applies to transmission systems, which is why for example Terna is only owned by the state and by nobody else.

Figure 1 shows a chorological summary of the most important dates in this Italian liberalization process.

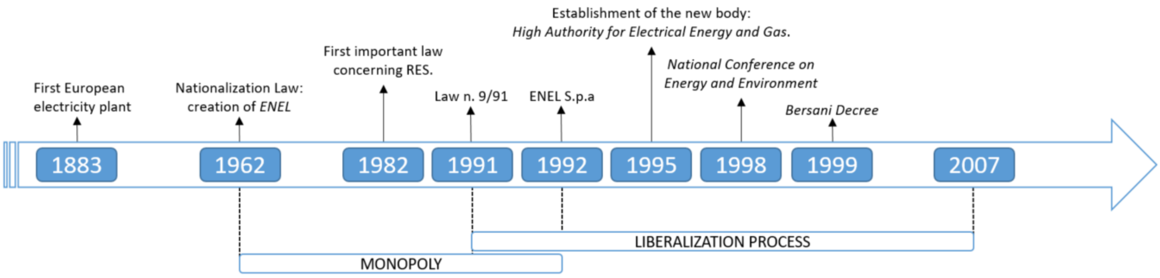

Figure 1: Highlights of the Italian Liberalization process. Own elaboration

Although formally nearly completed, the transformation is far from accomplished: the final users still have very little scope for choosing their supplier for electricity, the option being most of the time limited to one supplier alone, and competition being limited to a few cases of large industrial consumers. Energy is now supposed to be a ''shared responsibility'' between the central government and the regions: this should mean that the central government issues the guide-lines, and the local powers follow with legislation and application.

2.2. The Spanish market developments and liberalization

The Spanish electrical system is a sector with special characteristics. One of these is that both, transmission and distribution of electricity, in a monopoly, that is, when all production falls on a single company. Furthermore, the generation normally requires significant economies of scale, this is why much of the 20th century the sector was under a state monopoly, made up of a few companies and heavily regulated. This situation lasted until the end of the 90s when the liberalization of the sector began.

The normative regulation of the sector can be divided since the 1970s into three well-differentiated stages: the "*Planes Energéticos Nacionales*" – PEN (National Energy Plans), the "*Mercado Legal Estable*" – MLE (Stable Legal Market) and Liberalization [14].

2.2.1. National Energy Plans (PEN)

Industrial electrification was born in Spain with the constitution of the Spanish Electricity Society in 1875 in Barcelona, considered the first Spanish electricity company. At the end of the 19th century, many electricity companies, using direct current (DC) for transportation, were limited to short distances. For this reason, in 1901, 60% of the electricity came from thermal sources while the rest came from hydraulic ones. It is with the introduction of alternating current (AC) in the 20th century that long-distances electricity transport begins. This pushed the development of the hydroelectric industry, such is the case that at the end of the 1930s, Spain had 1500 MW of which 80% were hydroelectric. In the following decades, due to the civil war and the post-war period, there was a stagnation in the generation capacity, added with an increase in demand, a significant generation deficit emerged.

"Unidad Eléctrica S.A."- (UNESA), was founded in 1944 through the interconnection of regional electrical systems and the construction of new plants in addition to the creation of a centralized system to manage the National Electric System at all times. Finally the deficit could be alleviated thanks to the application of the "Tarifas Tope Unificadas" (Unified Top Rates) that promoted the construction of power plants. This allowed Spain to enter in a phase of accelerated growth (from 1960 to 1970) which, at the same time, generated higher energy demand.

During the 1970s, oil's price shot up firstly in the crisis of 1973 and then in the second crisis of 1979, which induced a global energy crisis. Price instability due to geopolitical reasons highlighted the need to reduce dependence on oil. The strategy of PEN's from 1975 to 1983 consisted of satisfying the increased demand and the reduction of dependence on oil, through investments in coal and nuclear power plants. This type of plants required of a large capital disbursement during the context of an economic crisis. Electricity rates, which were regulated by the state, did not undergo the necessary increase to assume the entire investment that was being made. All this generated an accumulated deficit in companies of the sector and endanger the viability of the system [14] .

2.2.2. Stable Legal Market (MLE)

The second regulatory stage, known as "*Mercado Legal Estable*" – MLE (Stable Legal Market), was created with the aim of alleviating this accumulated deficit in the sector. In 1983, both the Government and electricity companies reached an agreement and signed a first protocol[15]. In it is recognized that the bad economic situation of the sector was not due to the management of the companies and a series of measures were established for the sanitation of the sector. The main measures consisted of:

- nationalizing the electricity transmission network with the creation of the "Red Eléctrica Española" – REE;
- a revision of the last PEN;
- a change in the tariff policy.

In addition, the sector underwent a major restructuring with a large exchange of assets reducing in four electrical groups. Finally, with the approval of the new tariff system in 1987[16], the MLE began, which enabled the sector's financial crisis to be overcome.

Since the early 1990s, the aim of the European Economic Commission was to create a single electricity market across Europe. This market seeks to bring competition to all electricity sectors as well as the freedom to import and export electricity between countries of EU. These new rules for the sector were promoted by Directive 90/547/EEC [17] that deals with transport in networks and Directive 96/92/EC [11] established how the sector would be liberalized, the opening of networks to third parties, the creation of an organized market for electricity and the minimization of state's role in the system [14][18].

2.2.3. Market Liberalization

It is from Electricity Sector's Law 54/1997 [19] that Directive 96/92/EC was transposed, creating the basis of the current legislative framework for the Spanish electricity sector. This law creates the necessary tools to liberalize the market: separating regulated activities, such as transmission and distribution, from unregulated activities (also called free activities), such as generation and commercialization, in addition to the entry of REE into the stock market and privatizing certain parts of it. Finally, the Electricity Market Operator was created, which manages the generation offers and demands, and the National Energy Commission (CNE), the institution in charge of outlining the state policy in the Energy Sector[20].

The European Union continued the liberalization process of the electricity sector with Directive 2003/54/EC [21] with measures to accelerate this process. This directive was transposed in Spanish Law with the Law 17/2007.

Between 2001 and 2010 renewable energies became more protagonists with the "*Plan de Fomento de las Energias Renovables en España*"- The Plan for the Promotion of Renewable Energies (2000-2010)[22], the "*Plan de Energías Renovables*"- Plan for Renewable Energies (2005-2010) [23], and the still in force Spain's National Renewable Energy Action Plan (2011-

2020)[24] – "Plan de Acción Nacional de Energías Renovables". They looked to promote saving and efficiency, setting bonuses for the use and installation of renewables.

As mentioned previously, in 2007 the European Commission released an Action Plan with three main objectives for the entire European Union by 2020. The first was to achieve 20% of energy consumption with renewable energy, the second was to improve energy efficiency by 20% and the third to reduce CO2 emission by 20%.

Finally, it is with Law 24/2013 [25], stablished with the objective of "*establish the regulation of the electricity sector in order to guarantee the supply of electrical energy, and to adapt it to the needs of consumers in terms of safety, quality, efficiency, objectivity, transparency and minimum cost*", that the system recovers its financial balance thanks to the increase in new taxes and the reduction of premiums for certain activities. It should be said that this law thereby did not review or reform the sector, but limited itself to alleviating the tariff deficit.

Due to the need to reduce global CO2 emissions and energy dependence on fossil fuels however, the EU was forced to coordinate an energy plan. In essence, it becomes apparent that the Spanish regulatory framework of the last decades has been strongly influenced by the European Directives [14][18]. Figure 2 summarizes in chorological order the most important dates in this Spanish liberalization process:

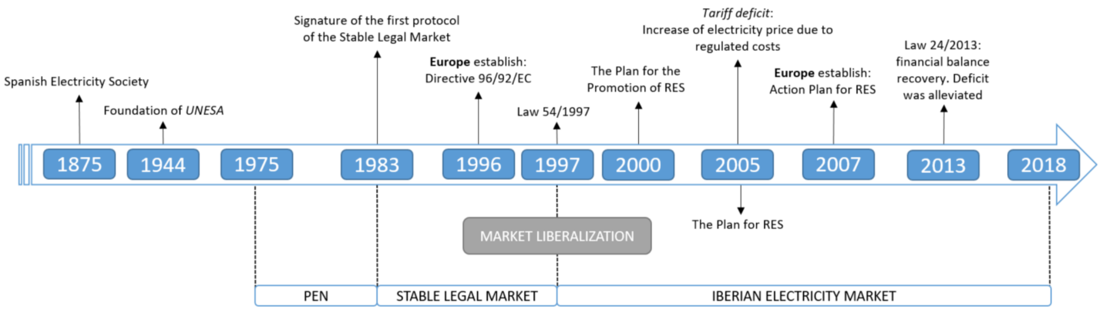

Figure 2: Highlights of the Spanish Liberalization process. Own elaboration

2.3. Growth of renewable generation

In this chapter the growth of renewable generation is described for the two analyses countries Italy and Spain, first on a general level and then specifically for wind and solar in each country.

2.3.1. Italy

The promotion of electricity produced from RES is among the priorities of the European Union (EU) for reasons of security and diversification of energy supply, for reasons of environmental protection and for reasons linked to economic and social cohesion.
With the Directive 2009/28/EC [26], the EU has identified the strategic plans to combat climate change by proposing short and medium-term measures aimed at the adoption of the following energy measures to be realized by 2020:

- +20% of energy from renewable sources in final energy consumption;
- -20% of energy consumption compared to the trend scenario, through efficiency energy;
- -20% of emissions into the atmosphere.

Each State member is required to adopt a National Renewable Energy Action Plan (NREAP), identifying strategies and implementing measures to improve energy efficiency in energy consumption and to increase the role of renewables in the transport sectors, electricity and heat.

Italy adopted its NREAP in June 2010. With the Legislative Decree 3/3/2011, n.28 [27] define the methods and criteria for the implementation of the measures envisaged by the NREAP, in line with the indications of the European Directive mentioned above, the objectives of which are to be achieved by 2020.

Among the general objectives they take on particular importance:

- The **reduction of emissions** of harmful gases for the climate (CH_4, CO_2…) according to the commitments undertaken at the international level.
- The **security of energy supplies**, considering that Italy depends heavily on energy imports. Examples of the problematic situation were: oil supply disruptions as a result of political events in Libya in 2011 and reductions in gas supplies from Russia through Ukraine.
- **Improving the competitiveness of the national industry** through support for the demand for renewable technologies and the development of technological innovation. The development of renewable sources could be an element of economic evolution, employment and investment for the country.

Regarding the objectives for renewable energy, Italy has assumed for the year 2020:

- To cover with renewable energy **17%** of gross final energy consumption.
- In detail this is shall be reached by a target of the share renewable energies to be 17,09% in the heating/cooling sector, 10,14% in the transport sector and 26,39% in the electricity sector.

Therefore, the development of renewable sources in the production of electricity remains a strategic action line. To increase the percentage of electricity consumption covered by renewable sources while ensuring efficiency and acceptable costs, it is necessary that the electricity system infrastructure is adequate; in particular, to aim at the realization of the so-called smart grids, capable of realizing efficient forms of storage, accumulation and sorting of the electricity produced. Table 1 illustrate the objectives that Italy intends to achieve in the three sectors (electricity, heat and transport) for the purpose of meeting the targets set, comparing the reference year 2005, the intermediate situation to 2008 and the forecasts for 2020.

Table 1: Summary National Renewable Energy Action Plan (NREAP). Source: [28]

	2005			***2008***			***2020***		
	RES	GFC	RES/GFC	RES	GFC	RES/GFC	RES	GFC	RES/GFC
	Mtoe	Mtoe	%	Mtoe	Mtoe	%	Mtoe	Mtoe	%
electric	**4,84**	**29,74**	**16%**	**5,04**	**30,39**	**16,58%**	**9,11**	**31,44**	**28,97 %**
heat	1,91	68,5	2,8%	3,23	58,53	5,53%	9,52	60,13	15,83%
transport	0,17	42,97	0,42%	0,723	42,61	1,7%	2,52	39,63	6,38%
total	6,94	141,2	4,91%	9	131,5	6,84%	22,3	131,2	17%

According to the Italian Ministry of Economic Development [28], in 2018, RES have consolidated their role by finding widespread use in all sectors (thermal, electrical and transport) and are confirmed as a strategic resource (also in economic and employment terms) for the sustainable development of the country. In 2018, the gross final energy consumption covered by RES has reached over 17,8%, a value well beyond the target assigned to Italy by the EU by 2020. The increased role of RES have contributed to the decrease in Italy's dependence on the supply of foreign sources. The share of national energy needs met by imports (while remaining high, equal to 74%), was further down and has for years been below historical values. The 2020 RES targets set for Italy appear within reach but, in the longer term, however their role will need to be further strengthened: i.e. the Integrated National Plan for Energy and Climate (PNIEC) sets an ambitious target for 2030 in terms of the share of total energy consumption covered by RES of 30%.

Along last decades, the Italian power system faced an intense energetic transition to Renewable Energy Sources, due to the increase of investments in Renewable Generation (RG) following several legislative initiatives supported by both the European Union and the Italian governments (e.g. "*Conto Energia*"[1], "*Conto Termico*"[2]). To exploit the potential of renewable energy production, Italy implemented generous incentive schemes: the largest scheme incentivised solar PV production and led Italy from a low base of installed PV in 2010 to become the world's fourth largest country by installations by the end of 2014.

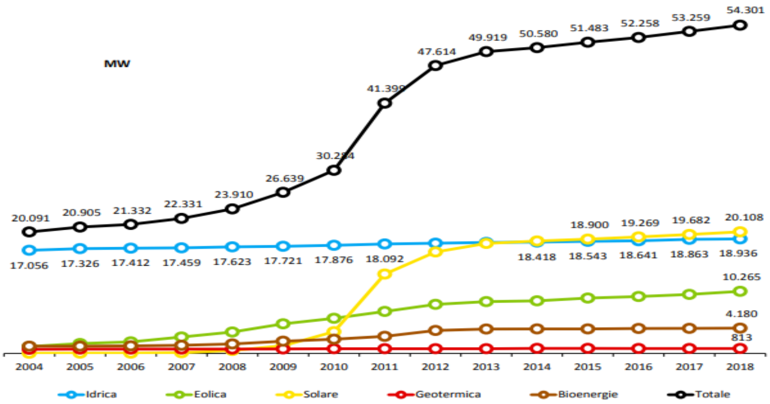

Figure 3: Evolution of installed power of electricity production plants powered by RES. Source [29]

[1] Italian Ministerial Decree of the 6th of February 2006

[2] Italian Ministerial Decree of the 28th of December 2012

Indeed, as it can be seen in Figure 3, between 2004 and 2018, the gross efficient power of RES plants installed in Italy increased from 20091 MW to 54301 MW, with an overall variation of 34210 MW and an annual average growth rate of 7%. Years with major increases in power are 2011 and 2012. The total installed power powered by RES that came new into operation in 2018 was 1042MW, a slightly higher increase compared to 2016-2017 (1001 MW).

The national electricity park has historically been characterized by a wide spread of hydroelectric plants; in recent years the installed power of these plants has almost remained constant: an average increase of 0.7% per year, while all other renewable sources, in particular solar and wind, have grown at a rapid pace, thanks mainly to the various public system’s incentives.

Figure 4 shows that, at the end of 2018, Lombardia is the region with the highest concentration of installed power of RES plants for electricity production (15.4 % of the total national power); in the North it is followed by Piemonte, with 8.7%, and Veneto (6.4%). Tuscany, mainly thanks to the exploitation of geothermal resource, is instead the region with the highest installed power in Central Italy (4.2%). In Southern Italy the first region for installed power is Puglia (10.2%) followed by Sicily, with 6.5% and Campania (5.2%).

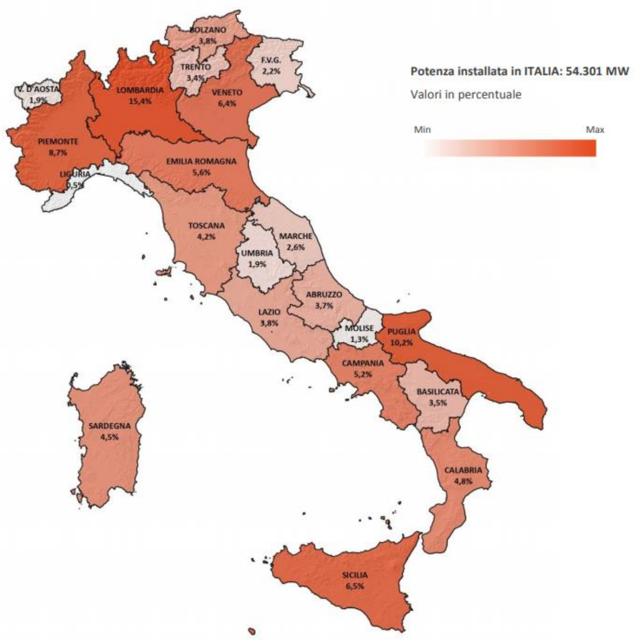

Figure 4: Regional distribution of installed RES power at the end of 2018. Source [29]

Regarding production, Figure 5 shows the evolution of RES electricity production of each renewable source. Solar energy alone accounted for about the 8% of total electric production in Italy in 2014, making the country one with the highest contribution from solar energy in the world. While the contribution of the traditional renewable sources of hydro and geothermal remained rather stable over the course of time, a rapid growth in the deployment of solar, wind and bio energy in recent years led to Italy producing over 40% of its electricity from RES (see Figure 6):

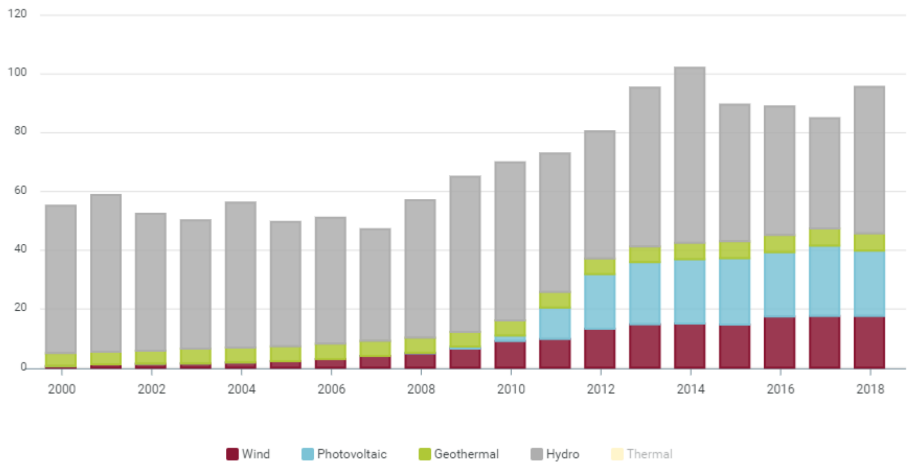

Figure 5: RES electricity production by source. Source: [2]

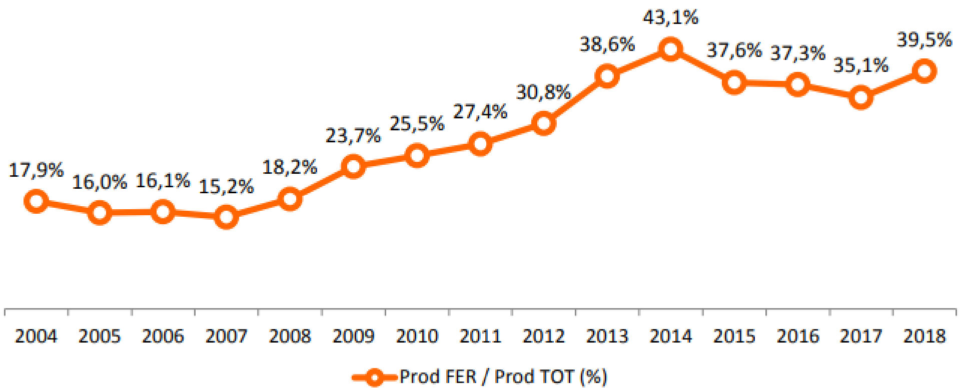

Figure 6: Gross electricity production covered by RES. Source [29]

Such impressive transition has been pushed by three main international economic and social drivers:

- Necessity of reducing pollution by substituting harmful sources to the environment (i.e. coal) with RES.
- Decreasing costs of RES investments. Photovoltaics' greenfield investment costs decreased by 75% from 2010 to 2017, as well as wind plants' costs, which decreased by 30% along the same reference period [30];
- Purpose of reaching the energetic independence from fossil fuels (especially countries with limited reserves of hydrocarbon deposits as Italy), by consumptions' electrification and consequent increase in electricity production.

As previously mentioned, RES electric production showed an increase (15% yearly from 2009 to 2014) along last decade, facing a slight decreased caused by the drop off hydroelectric production from 2015 to 2017 (-20%) although still showing an increase in the production of the other sources. Such increase of RES production has been supported by the Italian authorities through feed-in tariffs and fiscal benefits, as well as granting dispatchment priority to energy produced by RES in power markets.

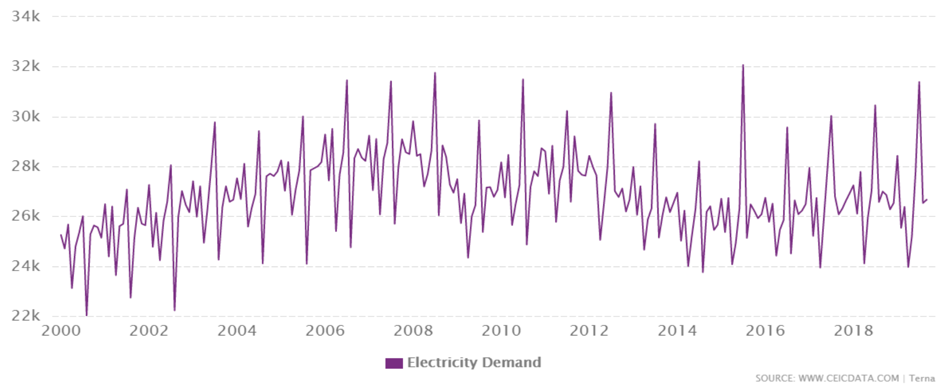

Figure 7: Italy Electricity Demand in GWh. 2000-2018. Source [31]

It can be seen in Figure 7 a strong fluctuation of demand, from 24k to 32k GWh within short time. Years characterised by the decrease of electricity demand average (from 2011 to 2014), RES production faced a regular growth, emphasising the transition from traditional power plants, (which faced several decommissionings), contributing less to the supply of electricity demand. Figure 8 shows the regional distribution of RES production in Italy.

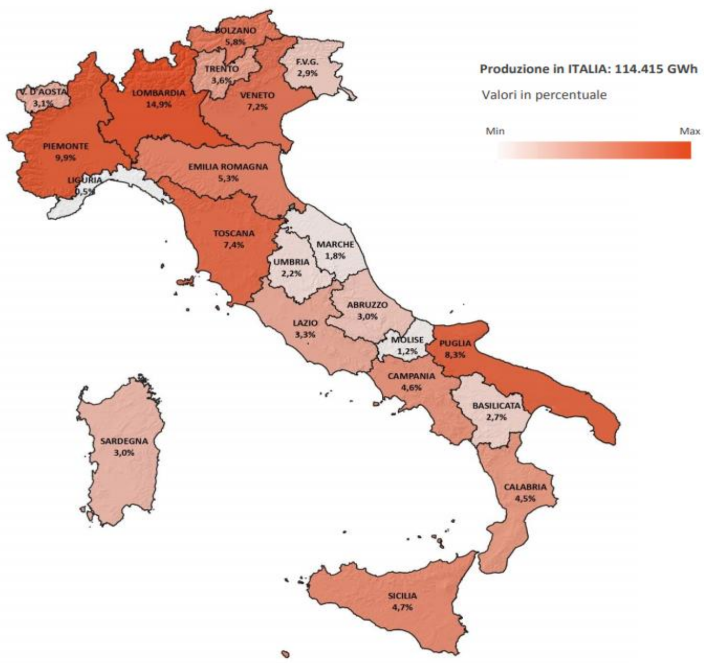

Figure 8: Regional distribution of RES production. Source [29]

It is described further in detail in the following sub-chapters the prevailing type of RES per region but in the North is hydro and in the South is PV and wind. As it can be seen in Figure8 in 2018, Lombardia is confirmed as the Italian region with the highest production from renewable sources: 17094 GWh (equal to 14.9% of the 114415 GWh produced overall in Italy), followed by Piemonte, with 9.9% of national production. In the South, Puglia excels with the 8.3%. Electricity generation from renewable sources is distributed as follows: Northern Italy 53.3%, Center Italy 14.6%, South (islands included) 32.1%.

2.3.1.1. Solar

At the end of 2018, 822.301 photovoltaic plants were installed in Italy, for a total power of 20.108 MW; most of them (about 92%) have less than 20kW. 37% of the installed power is concentrated in plants between 200-1000 kW. Overall, the power of PV represents 37% of that related to the entire RES capacity installed at national level in Italy. As reported in Table 2 in 2018, production from solar sources was 22.654 GWh, equal to 19.8% of total electricity production from renewable sources; 61% of the electricity generated by PV systems is produced by plants with size above 200 kW.

Table 2: PV plants installed in Italy in 2018. Source [2]

Classi di potenza	n°	Potenza (MW)	Energia (GWh)
P ≤ 3	279.681	760	806
3 < P ≤ 20	476.396	3.445	3.636
20 < P ≤ 200	54.209	4.244	4.375
200 < P ≤ 1.000	10.878	7.413	8.548
P > 1000	1.137	4.245	5.289
Totale	**822.301**	**20.108**	**22.654**

Distribution of installed PV capacity in Italy

Figure 9 shows the evolution of the time series of the number and installed power of PV systems in Italy. It can be seen that since 2013, with the end of the "*Conto Energia*" law, the growth rates in terms of capacity are significantly less sustained. Overall numbers of plants continue however to increase, indicating that specifically the growth of recent years is attributed mostly to small (residential) plants. At the end of 2018, 822.301 PV systems were installed in Italy for a total power of 20.108 MW. Small plants (power less or equal to 20 kW) make up more than 90% of the total plants installed in Italy and concentrate 21% of the overall national power.

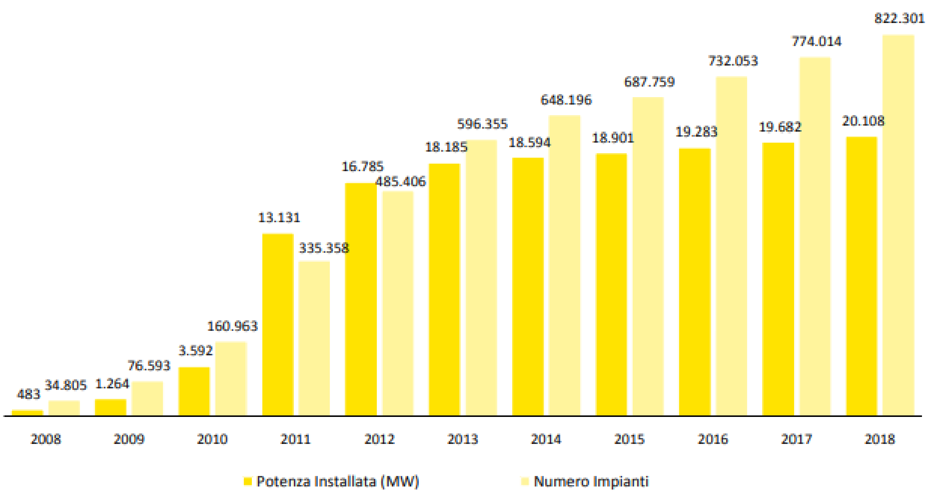

Figure 9: Evolution of the number and power of PV. Source [29]

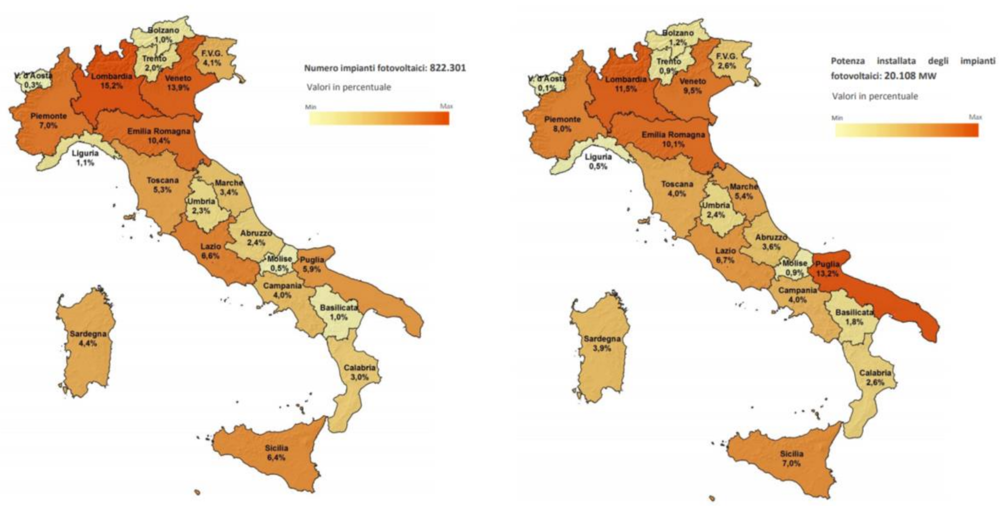

Figure 10: Regional distribution of solar plants in terms of installed plants (left) and power installed (right) until end of 2018. Source: [29]

The incremental installation of PV systems in 2018 did not cause significant changes in the relative territorial distribution, which remains almost unchanged compared to 2017. The highest concentration of solar plants in terms of installed plants is found in the Northern regions (approximately 55% of the total); in the Center about 17% and in the South the remaining 28%. Regarding installed power (Figure 10, right), 44% is concentrated in the North, 37% in the South and 19% in Central Italy. Puglia is the region characterized by the greatest contribution (13.2%) followed by Lombardia (11.5%). Lazio excels in the Center, with a 6.7%.

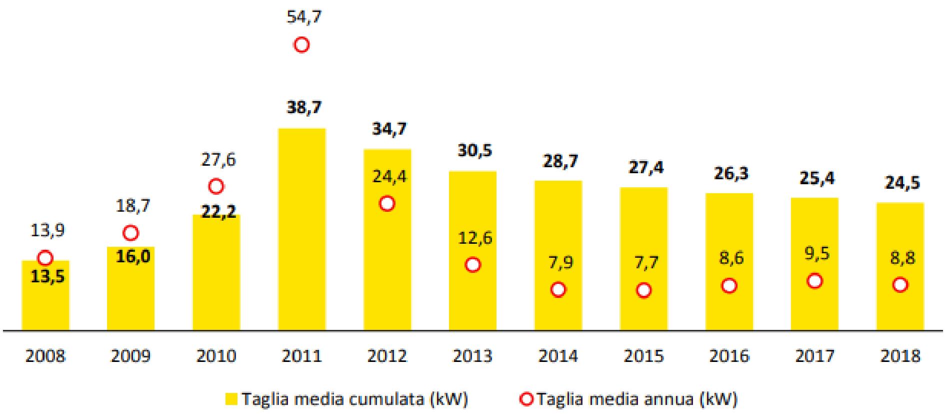

Figure 11: Average size of newly installed PV systems. Source [29]

Plants that came into operation in 2018 (mostly installations for domestic users), have an average power of 8,8 kW and the overall national average size of PV systems has gradually decreased since 2012; in 2018 stood around 24,5 kW.

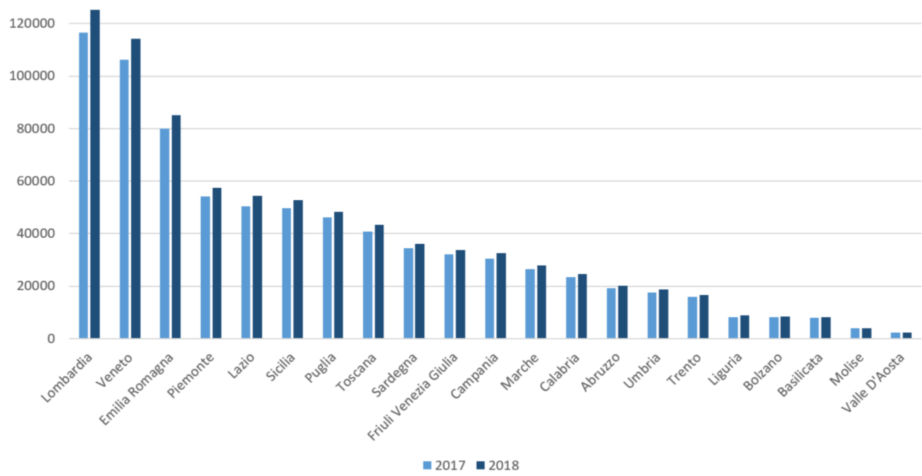

Figure 12: Number of PV plants by regions. Source: [29]

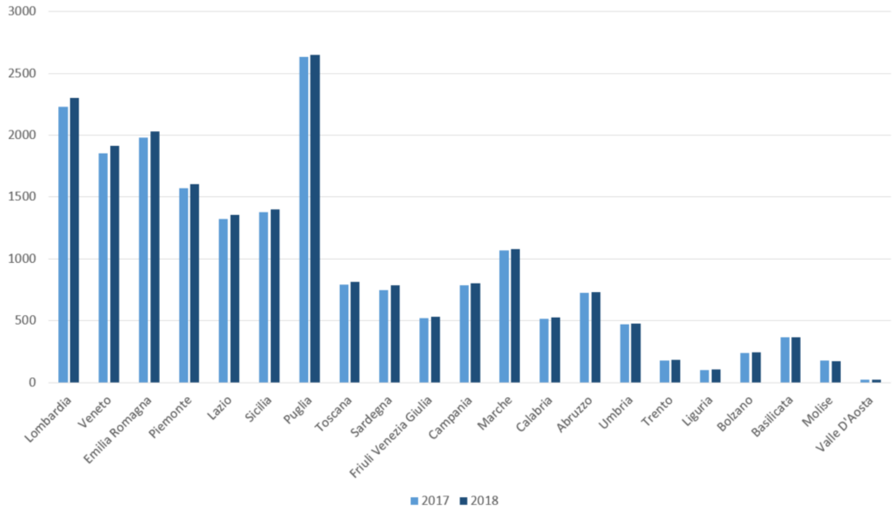

Figure 13: Power of PV plants by regions in [MW]. Source [29]

According to Figure 12 and Figure 13, at the end of 2018, Lombardia is the region with the largest number of installed plants (125.250), followed by Veneto with 114,624 plants. Puglia is characterized by the greater installed power (2.652 MW), followed by Lombardia with 2.303 MW. In general: plants in the south are fewer in numbers, but larger in terms of installed capacity. This is because a lot of these plants are utility-scale (e.g. green-fields). The North on the other hand has much more in terms of numbers, but smaller capacity because to a big share of roof-top plants of residential or industrial facilities. According to the "Gestore Servizi Energetici" (GSE) – Energy Services Manager.

Table 3 shows the variation in terms of number and power of photovoltaic plants of each Italian region.

Table 3: % power and number variation between 2017 and 2018. Source [29]*. Own elaboration*

	% Variation 2017/2018			% Variation 2017/2018	
	Nº	MW		Nº	MW
Lombardia	7.4	3.4	Campania	6.9	2.7
Veneto	7.6	3.2	Marche	4.6	1.0
Emilia Romagna	6.7	2.4	Calabria	5.0	2.0
Piemonte	5.8	2.1	Abruzzo	5.5	1.3
Lazio	8.0	2.1	Umbria	6.0	1.8
Sicilia	5.8	1.7	Trento	4.2	2.7
Puglia	4.6	0.8	Liguria	7.5	4.4
Toscana	5.8	2.6	Bolzano	2.4	1.3
Sardegna	4.4	5.1	Basilicata	3.3	0.5
Friuli Venezia Giulia	5.1	2.0	Molise	3.3	1.4
Valle D'Aosta	4.9	3.1	**ITALIA**	**6.2**	**2.2**

In 2018 there was an increase in the number (+6.2%) and power (+2.2%) of photovoltaic plants more contained than in previous years. The greatest variation in the number of plants (+8.0%) is observed in Lazio, followed by Lombardia, Veneto and Liguria; the smallest increase (+2.4%) is recorded in Bolzano. Regarding PV production, Figure 14 shows that in 2018 Italy reached 22.654 GWh, a sharp drop compared to the previous year (-7.1%). It represented 19.8% of the 114 TWh produced from all renewable sources in Italy [29].

<u>Distribution of generated PV capacity in Italy</u>

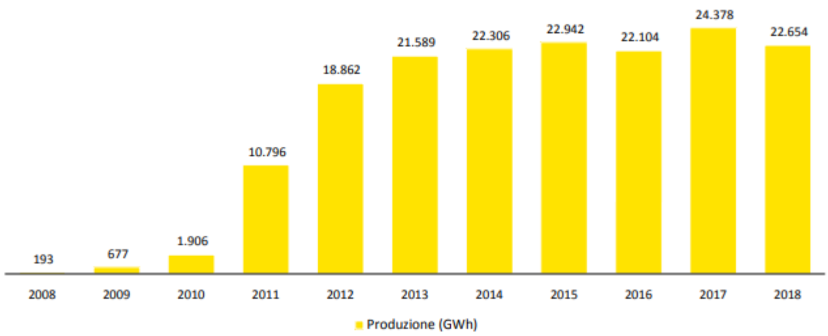

Figure 14: Evolution of PV production. Source: [29]

Figure 15 shows the regional distribution of national electricity production from PV systems in 2018. Puglia, with 3438 GWh, is the region with the highest production (15.2% of the total); followed by Lombardia, with 9.9% and Emilia Romagna with 9.7%. Valle d'Aosta and Liguria are the regions with the lowest photovoltaic production (0. 1% and 0.5% respectively).

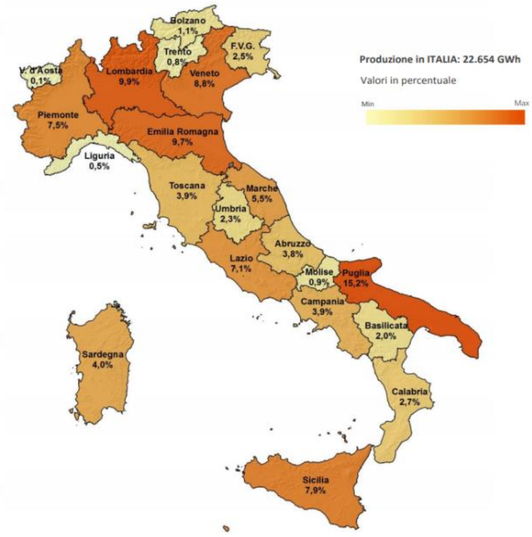

Figure 15: Regional distribution of national electricity production from PV systems in 2018. Source [29]

2.3.1.2. Wind

At the end of 2018, 5.642 wind farms were installed in Italy, most of which (92%) were small (less than 1 MW). Of the 10.265 MW installed in Italy at the end of 2018 (19% of the entire installed capacity of renewable energy sources at national level), 86% (9.082 MW) was concentrated in 308 wind farms with a power higher than 10 MW. During 2018, wind production was 17.716 GWh, corresponding to 15.5% of the total electricity production from renewable sources. As highlighted in Table 4, 90% of the electricity generated by wind farms was produced by plants with a power higher than 10 MW, 6% by those with power between 1 and 10 MW and the remaining 4% by plants below 1 MW [29].

Table 4: wind farms installed in Italy in 2018. Source: [2]

	2017		2018		2018 / 2017 Variazione %	
Classi di potenza (MW)	**n°**	**MW**	**n°**	**MW**	**n°**	**MW**
P ≤ 1 MW	5.175	491,0	5.209	507,6	0,7	3,4
1 MW < P ≤ 10 MW	117	619,4	125	675,2	6,8	9,0
P> 10 MW	287	8.655,5	308	9.081,9	7,3	4,9
Totale	**5.579**	**9.765,9**	**5.642**	**10.264,7**	**1,1**	**5,1**

According to Table 4 , the power's increase between 2017 and 2018 (+499 MW, equal to 5.1%) is mainly linked to the growth of these plants with power higher than 1 MW, in both terms: size (5.9%) and installed power (5.2%). The segment of power plants less than 1 MW, which also includes small wind turbines, represents only 16.6 MW of the almost 500 MW installed in 2018 (approximately 3%).

Distribution of installed wind capacity in Italy

Figure 16 shows the evolution of the time series of the number and installed power of wind farms in Italy.

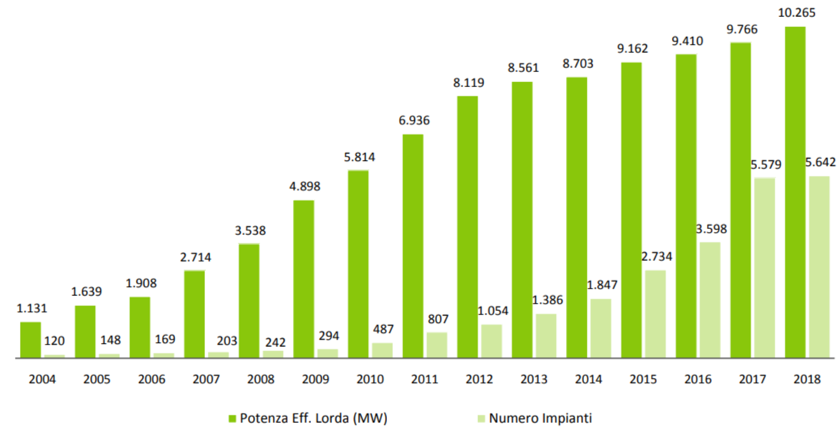

Figure 16: Evolution of number and power of wind farms. Source [29]

In the last fifteen years, a quick development of wind farms has been observed in Italy: in 2004 there were only 120 plants installed, with a power of 1131 MW, while at the end of 2018 the national park was composed of almost 5642 plants with 10265 MW of total power. In 2018, the installed wind power represented 18.9% of that relating to the national capacity of renewable energy plants.

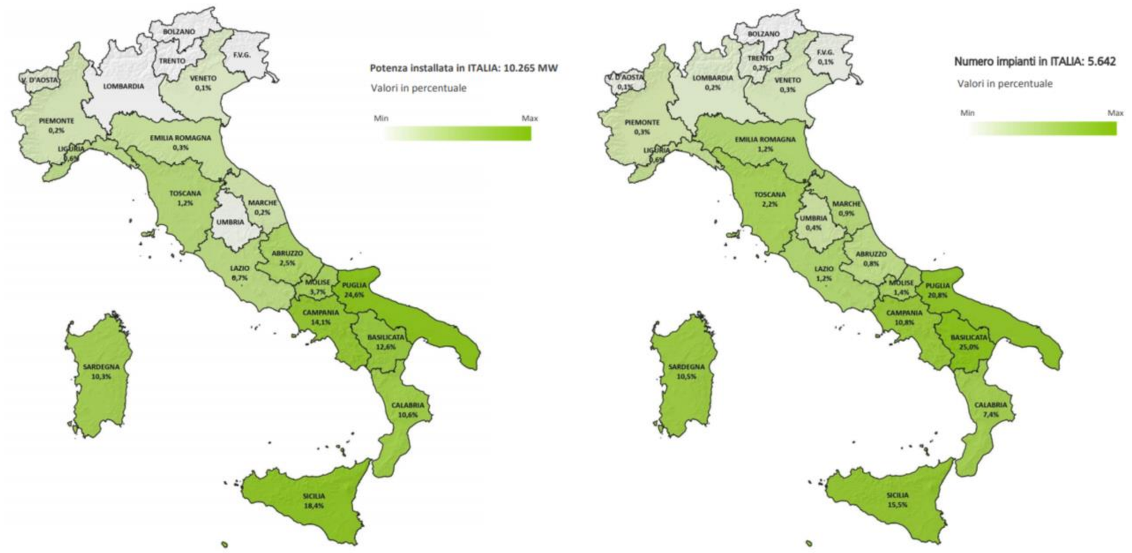

Figure 17: Regional distribution of wind farms by installed power (left)and number of installed plants (right) at the end of 2018. Source: [29]

As it can be seen in Figure 17 southern Italy has the highest number of wind farms; Basilicata is the region with more percentage of plants on the national territory (25 %), followed by Puglia (20.8%). In northern Italy, the spread of these plants is much more modest; the most representative regions are Emilia Romagna and Liguria, with 1.2% and 0.6% respectively. Finally in central Italy, the region characterized by the greatest presence of wind plants is

Tuscany with 2.2% of the total. Regarding the regional distribution of the power: in northern and central Italy, the plants installed at the end of 2018 cover, considered together, only 5.2% of the total national power. Puglia with 24.6% and Sicily with 18.4% hold by far the highest value for installed power; together with the also significant regions of Campania, Calabria, Basilicata and Sardinia. According to Figure 18, the overall national average size of wind farms has gradually decreased since 2010; in 2018 it stood at around 1.8 MW.

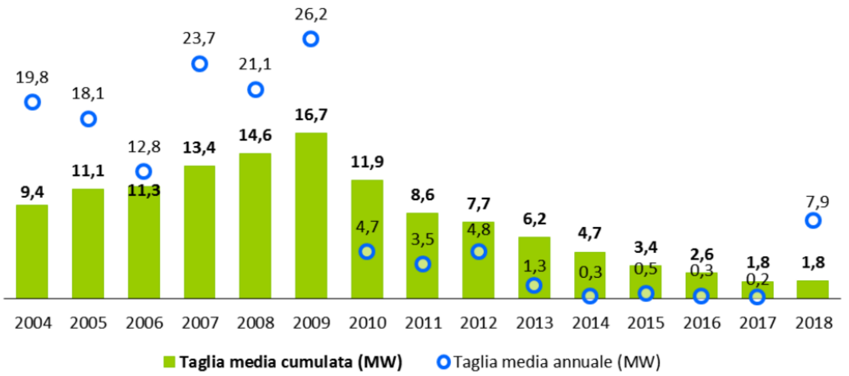

Figure 18: Average size of installed wind farms. Source [29]

Table 5 shows the variation in terms of number and power of wind farms for each Italian region.

Table 5: Percentage power and number variation between 2017 and 2018. Source [29]. *Own elaboration*

	% Variation 2017/2018			% Variation 2017/2018	
	Nº	MW		Nº	MW
Piemonte	5.9	0.0	Marche	-1.9	-0.1
Valle d'Aosta	0	0.0	Lazio	2.9	33.7
Lombardia	11.1	4.3	Abruzzo	9.3	9.9
Trento	-	-	Molise	0.0	0.0
Bolzano	-66.7	-6.5	Campania	2.5	3.8
Veneto	-6.3	-0.0	Puglia	0.1	2.1
Friuli	0.0	0	Basilicata	0.7	22.6
Liguria	0.0	-2.7	Calabria	1.2	0.3
Emilia Romagna	1.4	0.0	Sicilia	1.5	4.5
Toscana	0.8	0.0	Sardegna	2.2	3.1
Umbria	0.0	0.0	**ITALIA**	**1.1**	**5.1**

For the construction and operation of wind farms, certain environmental and territorial characteristics of the sites, such as wind, orography, accessibility, are particularly important. For that reason, the presence of wind farms is not homogeneous on the national territory: in Southern Italy, in particular, is concentrated the greatest number of wind farms (32.4%) and the 96.8% of the country's overall wind power. The region with the highest installed power is Puglia, with 2523.3 MW; followed by Sicily and Campania with 1892.5 and 1443.2 MW respectively.

Distribution of generated wind capacity in Italy

Figure 19 shows the evolution of national electricity production from wind farms in 2018 according to GSE.

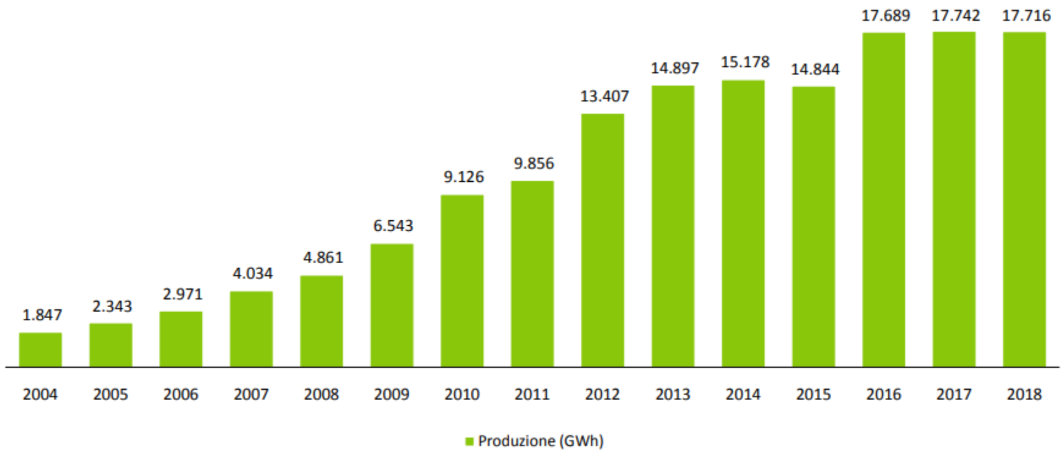

Figure 19: Evolution of wind production. Source: [29]

Between 2004 and 2018 the production of electricity from wind sources has almost increased tenfold, going from 1847 GWh to 17716 GWh; in 2018 the production value remained substantially unchanged compared to 2017 (-0.1%). With 4594 GWh of electricity produced, Puglia holds the first place of wind production, followed by Sicily (3211 GWh) and Campania (2494 GWh). These three regions together cover 58.1% of the national overall. [29]

As it can be seen in Figure 20 most of the national wind production is generated in the southern regions and the islands; in the North, however, lower values are recorded, due to the limited installed power. Among the regions, Puglia hold the first place with 25.9% of the national wind production in 2018. Followed by Sicily (18.15%), Campania (14.1%), Basilicata (12.1%) and Calabria (11.6%). While PV has a concentration in the northern and southern regions in Italy, the electricity generation from wind is clearly concentrated predominately in the South.

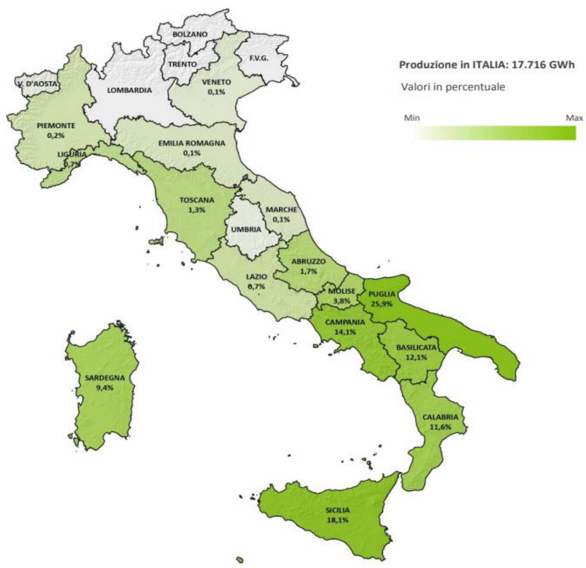

Figure 20: Regional distribution of wind production. Source: [29]

2.3.2. Spain

Renewable energy production in the Spanish electricity system has grown in 2018, due to the increase in hydraulic and wind production. 100.314 GWh of renewable energy generation (+19% compared to 2017) [32]. At the end of 2018, renewable generation in Spain amounted to 48612 MW (just over 38% of total generation) above the 32% of the previous year.

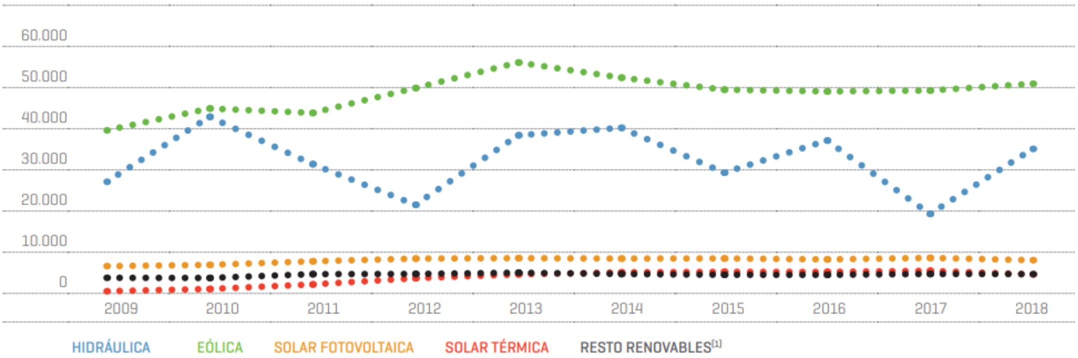

Figure 21: Evolution of renewable generation in GWh. Source [32]

On year 2018, according to Figure 22, the renewable installed capacity has grown 0.9% over 2017, which means 427 MW more. This increase has been made, mainly with wind technology (which has contributed 88.4% of the new power). The second source in contribution to the new renewable power (at a great distance from wind) has been the photovoltaic solar with an additional 26 MW from 2017 to 2018. The rest of renewable sources have had very little or no increments. In any case, it is noteworthy that, since 2009, have been installed in Spain more than 8500 MW of renewable energy have been installed in Spain.

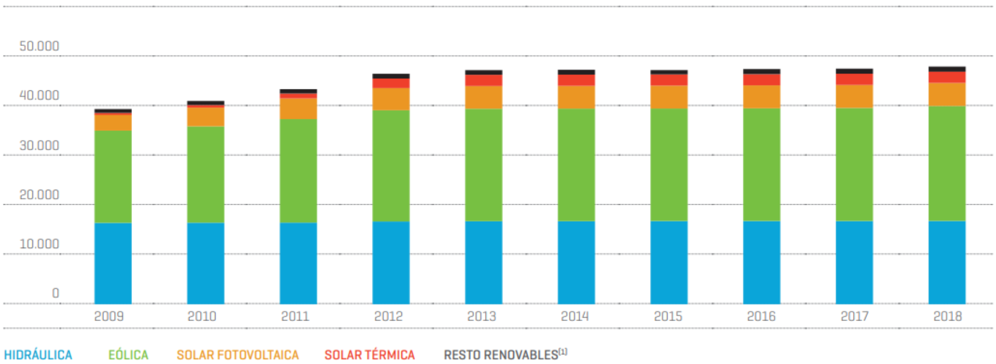

Figure 22: Evolution of renewable installed power. MW. Source [32]

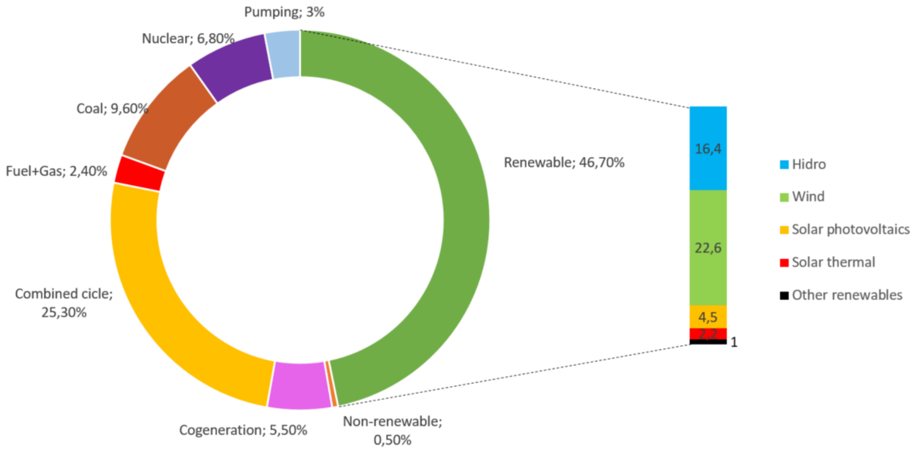

Figure 23: Percentage of installed power in Spain at the end of 2018. Source [32]*. Own elaboration*

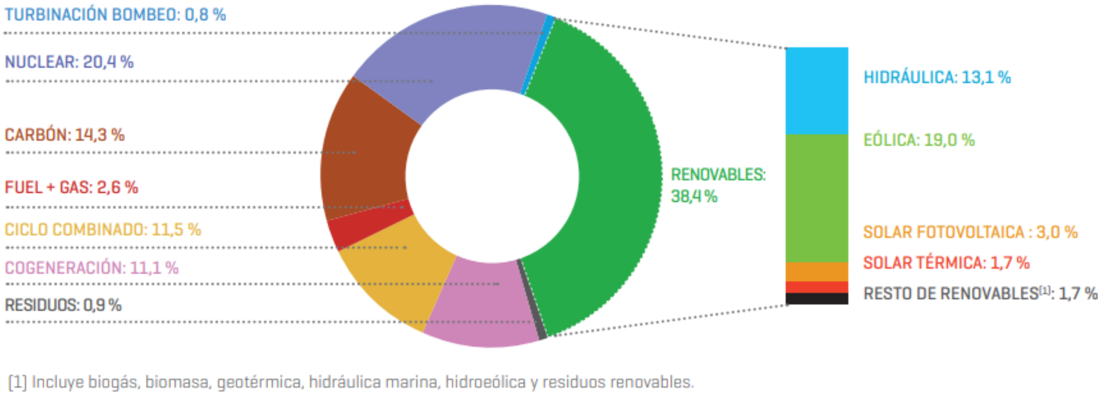

Figure 24: Structure of the electricity generation at the end of 2018. Source [32]

The increase in renewable generation, coupled with the decrease in total production, has led to the reduction of conventional thermal production, with the consequent decrease in C02 emissions that have been reduced 13.8% compared to the previous year (standing at little bit higher levels than in 2016). Wind contributes in 19% of the total national generation, being the second generating source after nuclear, maintaining high levels of participation. According to Figure 24, Spain's generation mix is differing from Italy's not only on the RES side, but also by the fact that nuclear is present with a notable share of 20% and gas (also due to the coal share) has a relatively smaller share.

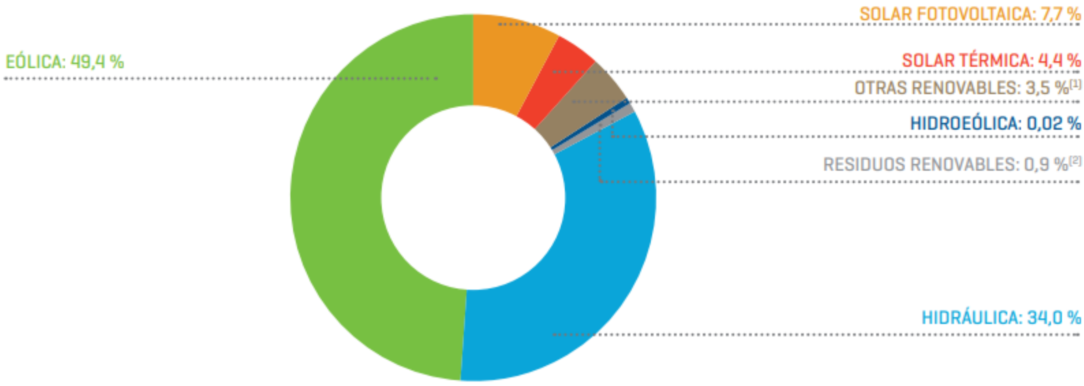

Figure 25: Structure of renewable energy generation at the end of 2018. Source [32]

In Figure 25 we can see that regarding renewables, during 2018, wind power continues to be the leader, accounting for just over 49% of the total renewable generated nationwide (considerably less than 2017 due to the increase of hydraulic generation). Wind power production has grown for the second year in a row running with a variation of 3.5% compared to 2017. With this technology, it has been produced 49570 GWh (a value still lower than a 9.4% recorded in 2013). Regarding the geographical distribution of renewable power (Figure 26), five Autonomous Communities (regions) concentrate almost 70% of the RES installed power in Spain. There are, ordered from highest to lowest: *"Castilla y León"*, *"Galicia"*, *"Andalucía*", *"Castilla-La-Mancha"* and *"Extremadura*".

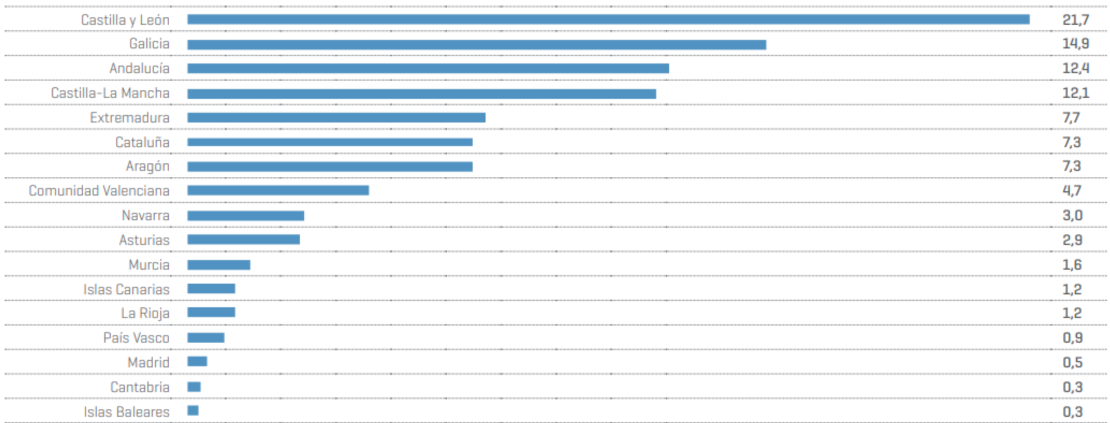

Figure 26: Regional distribution ratio renewable installed power/total power. Source [32]

According to Figure 27, Castilla y León, Navarra, Aragón, Galicia, Castilla-La-Mancha and La Rioja, more than 50% of their generation has been renewable. Among them, it should be noted the participation of renewable energy on the total generation of Castilla y León accounted for more than 75%.

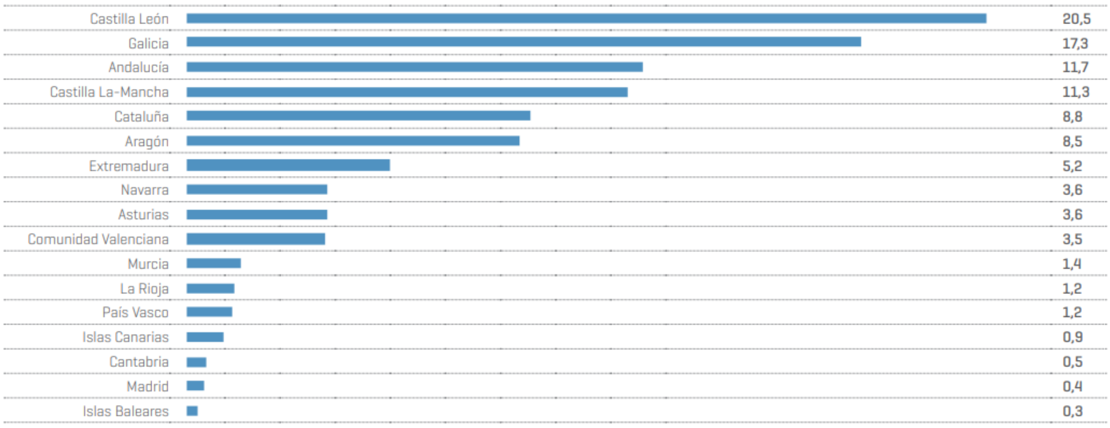

Figure 27: Community distribution ratio renewable generation/total generation. Source [32]

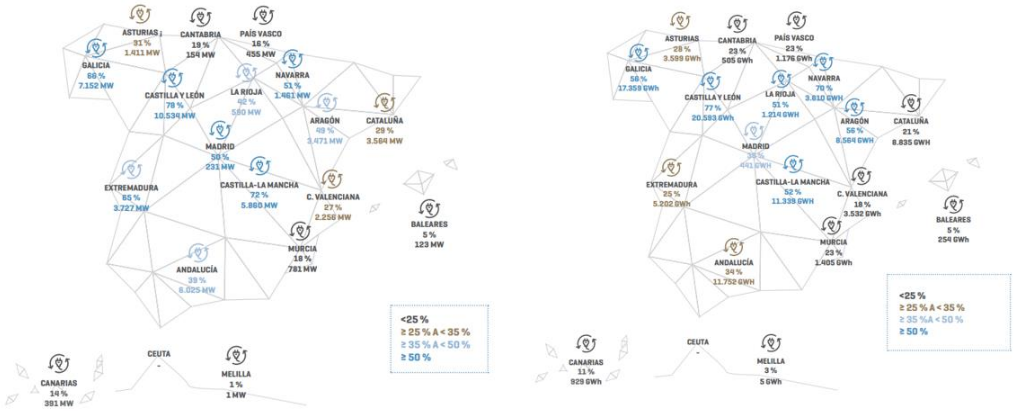

Figure 28: Geographical distribution of renewable power/total power (left) vs renewable generation/total generation (right) at the end of 2018. Source [32]

Compared to the rest of European countries, Spain has risen from sixth to fifth position by volume of renewable generation. Regarding Figure 29 the share of renewable energy with respect to total generation, Spain continues to present data above the European average, with the particularity that 2018, coinciding with the high hydro generation, the difference compared to the average of the other European countries has been 7% (compared to 3.5% the previous year).

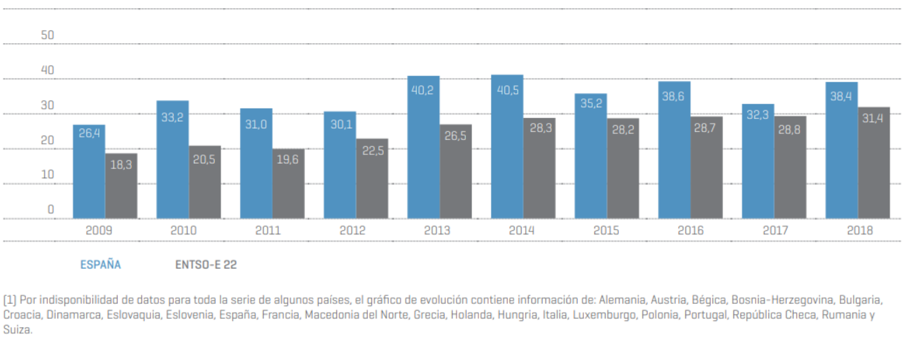

Figure 29: Comparison of renewable generation/total generation between Spain (blue) and the average of the countries member of ENTSO-E22[3]

[3] Germany, Austria, Belgium, Bosnia, Bulgari, Croatia, Denmark, Slovakia, Slovenia, Spain, North Macedonia, Greece, Netherlands, Hungary, Italy, Luxemburg, Poland, Portugal, Czech Republic, Romania and Switzerland.

2.3.2.1. Wind

As mentioned previously, in 2018 wind generation is the main renewable source in Spain, with 49750 GWh generated and 23507 MW of installed power. This means 3.5% more than the national wind generation in 2017 and 19% of the total energy generate nationwide. Overall represents 22.6 % of national power installed, being the second technology behind the combined cycle (Figure 23).

<u>Distribution of installed wind capacity in Spain</u>

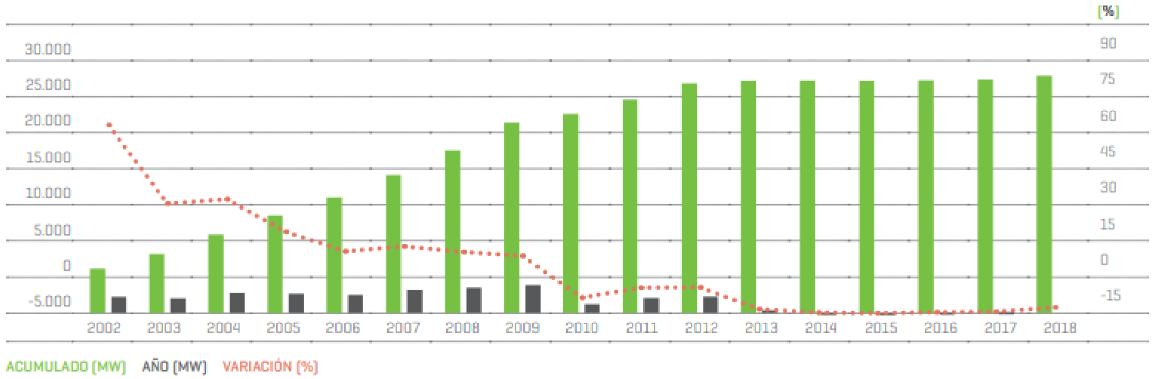

Figure 30: Evolution of wind installed power in MW. Source [32]

Looking to Figure 30 the installed power increased constantly from the early 2000s until 2012, but from then onwards only little additional capacity has been installed. Wind energy generated in 2018, has increased by almost 3.5% compared to that registered in 2017, being highlighted in Canary Islands, its production has increased by more than 56%.

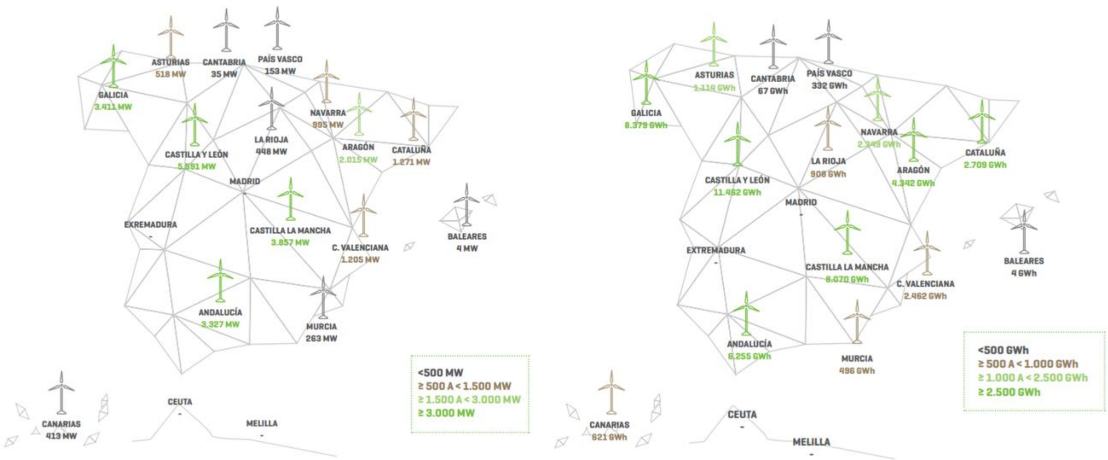

Figure 31: Wind power installed (left) vs wind generation (right) at the end of 2018. Source [32]

It should to be noted in Figure 31 the increase in power in the Canary Islands, which has doubled (compared to 2017) from 206.9 MW to 412.7 MW. Specifically outstanding is the strong increase of Tenerife, with just over 126 new MW installed (more than 61% of the new wind power installed in the Islands). In Gran Canaria, 50 MW have been installed, while the rest correspond, practically in equal parts, to Lanzarote and Fuerteventura [32]. Regarding communities and according to Figure 32, Castilla y León is the one with the most installed wind power, followed by Castilla-La Mancha, Galicia and Andalucía. It is noted that these four communities concentrate almost 70% of the installed wind power in the country. Balearic Islands, Cantabria and Basque Country stand out on the opposite side, below 1% compared to the national group.

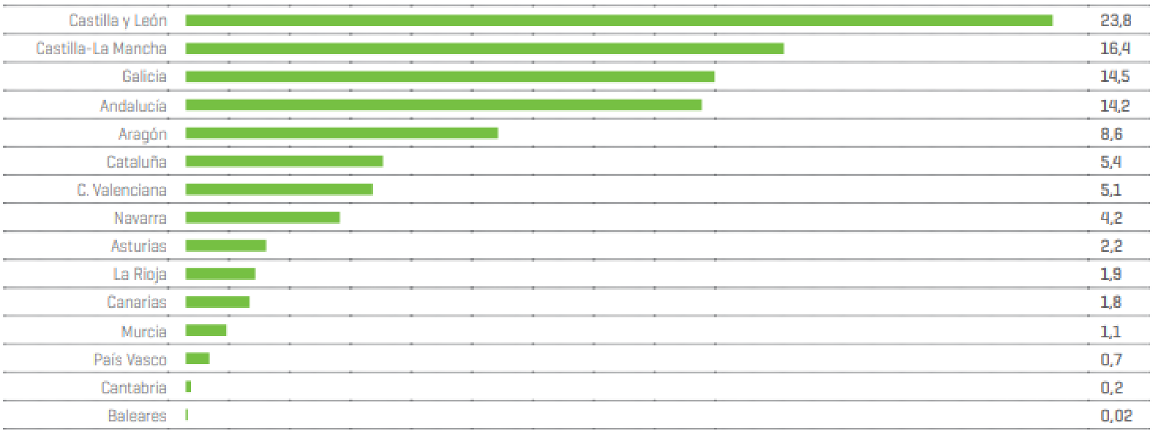

Figure 32: Percentage of wind power over total national wind power by communities. Source [32]

Figure 33 shows the evolution of national electricity production from wind farms and the percentage of wind over the total generation in Spain in 2018 according to REE.

Distribution of generated wind capacity in Spain

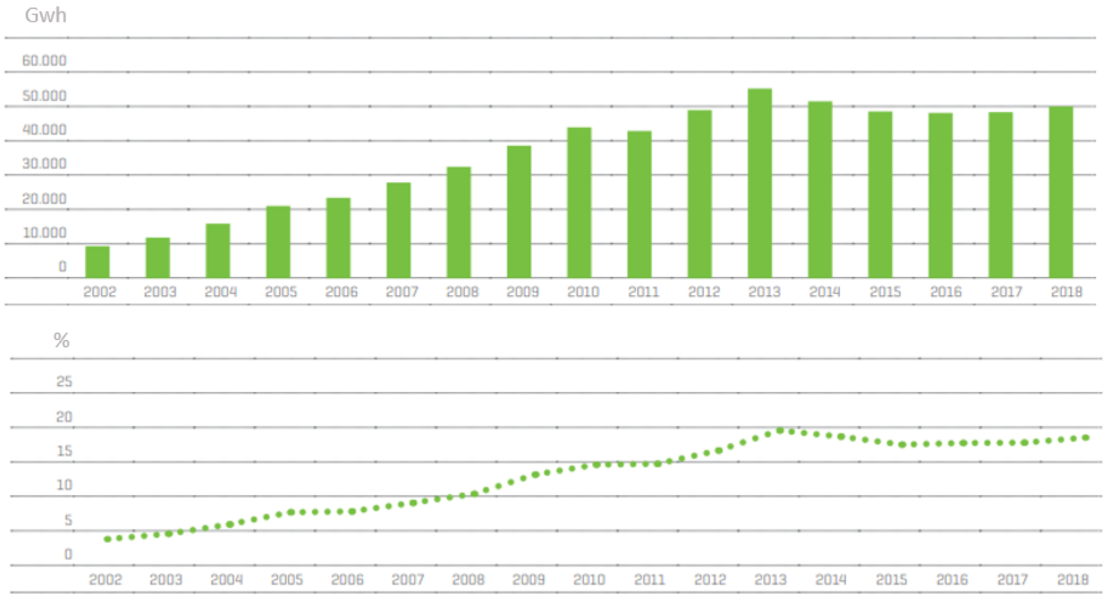

Figure 33: Evolution of wind generation in GWh (top) and percentage of wind over total generation (bottom). Source [32]

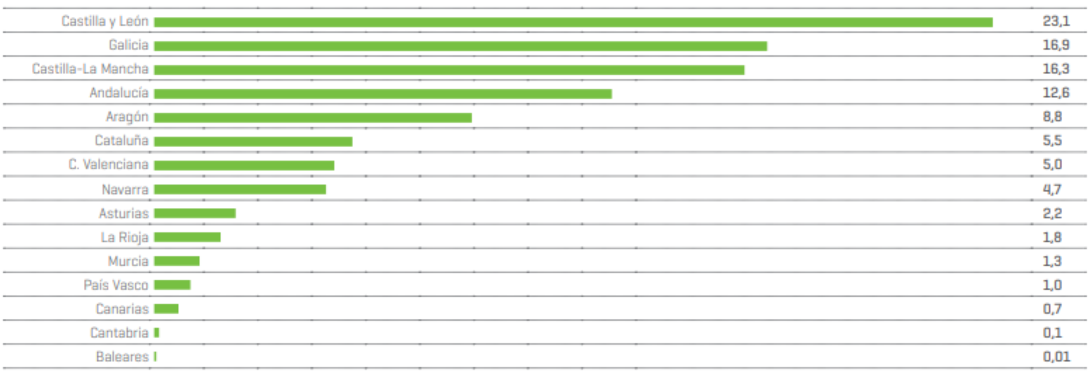

Figure 34: Percentage of wind generation over total national wind generation by communities until 2018. Source [32]

According to Figure 35, compared to the rest of the European countries Spain, with its overall capacity of 23.5 GW, remains in the second place with the largest installed wind capacity behind Germany, which is clearly the leader with just over 58 GW installed, followed in third place by Great Britain. Regarding the contribution of this source in the total generation, the outstanding leader is Denmark with just under 50% of its production coming from wind, being Spain in fifth place. However, Spain remains the leader in wind contribution to the national generation mix, followed by Germany with two fewer points.

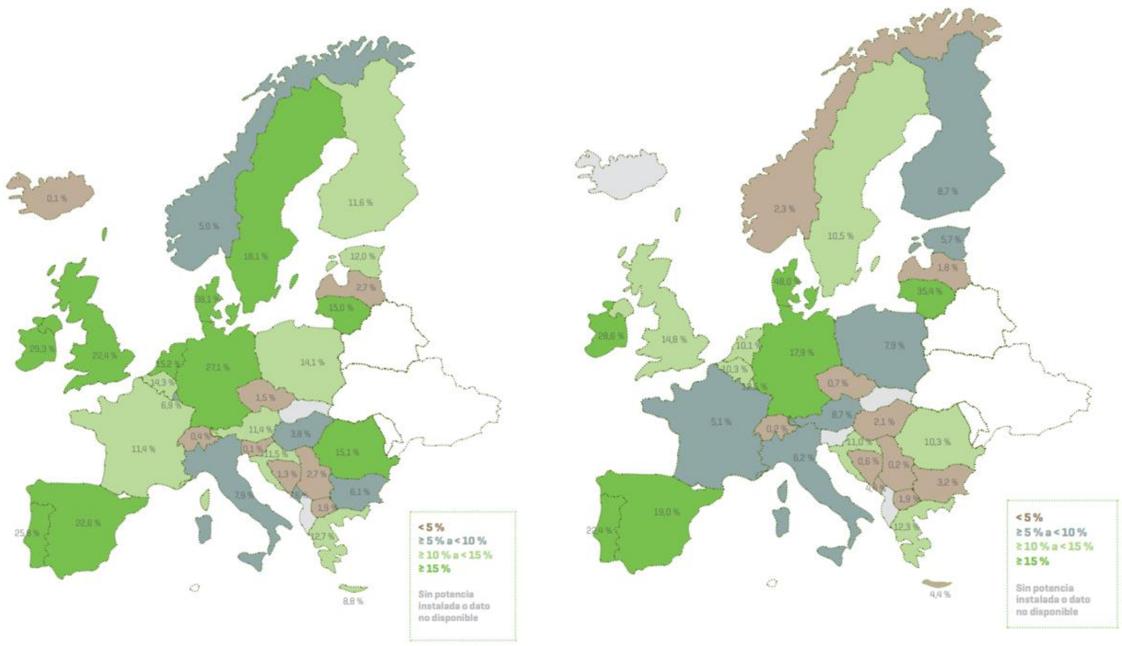

Figure 35: Wind power over total power (left) vs wind generation over total generation (right) in ENTSO-E member countries.

2.3.2.2. Hydro

Hydro generation has been 1.8 times higher in 2018 compared to 2017, due to the increased rainfall. In 2018, it generated 34106 GWh which corresponds to 13.1% of the total energy generate nationwide. Hydro power has traditionally been the main renewable source in Spain, until 2009 when it was surpassed by wind power. Since then, it has clearly remained the second renewable source for installed power, with a total of 17049 MW at the end of 2018. Regarding the total national installed capacity (renewable and no-renewable), hydro represents 16.4%, which places it as the third technology behind combined cycle and wind.
Figure 36 reports the evolution of installed hydro power in Spain from year 2002 until 2018.

<u>Distribution of installed hydro capacity in Spain</u>

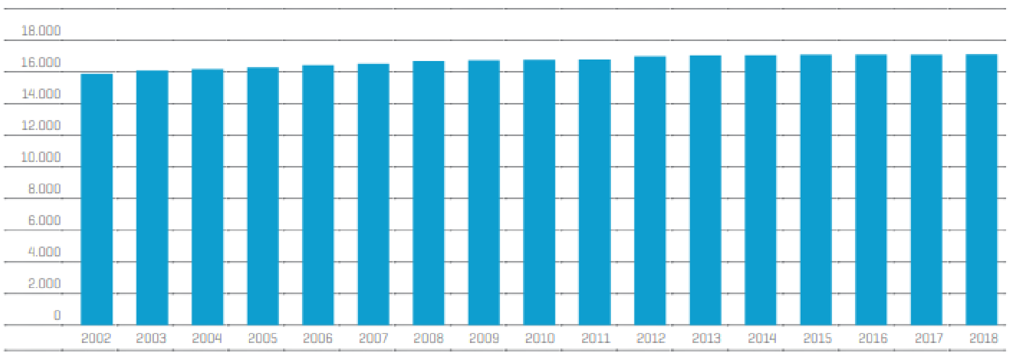

Figure 36: MW of installed hydro power. Annual evolution. Source [32]

Figure 37 shows the Spanish hydro power installations at the end of 2018. Those ones with more installed power were “Castilla y León” and “Galicia” with more than 3000 MW.

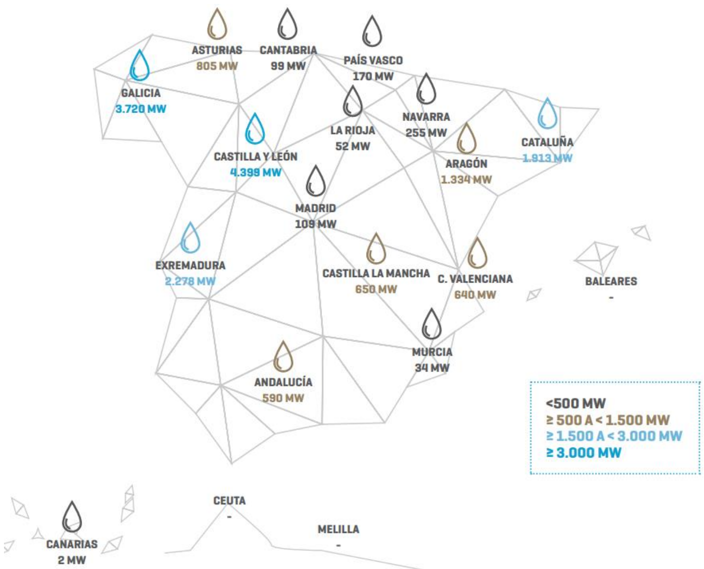

Figure 37: Installed hydro power in Spain at the end of 2018. Source: [32]

Distribution of generated hydro capacity in Spain

As it can be seen in Figure 38 hydro generation in Spain is highly variable, arriving in wet years to exceed 40.000 GWh, while in dry years that volume is reduced to more than a half. 2018 has been a wet year, placing production at 34106 GWh, 85% higher than 2017. In this way hydro contributed 13.1% to the total national production, occupying the fourth position of generating technologies.

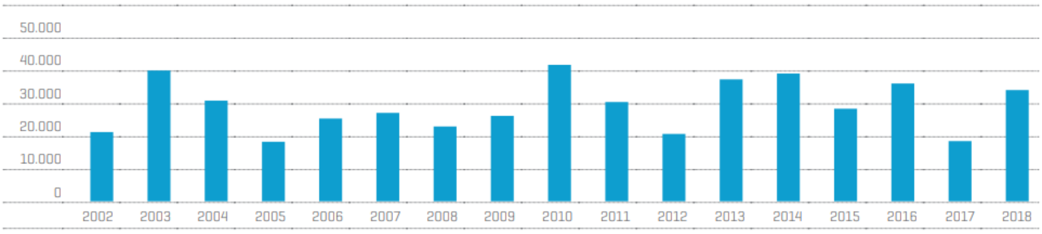

Figure 38: Hydro generation in GWh. Annual evolution. Source [32]

In comparison to the generation from other renewables, hydro power ranked second behind wind power with 34% of total renewable energy generated in Spain (Figure 25). As it can be seen in Figure 39, the last months of winter and the firsts of spring are these periods with higher hydro contribution present historically, mainly due to the melting snow in the mountains and also to the greater rainfall of those months. In 2018, April was the month in which most hydro generation came out with slightly more than 4700 GWh (74.7% higher than the maximum value of the previous year). Figure 39 shows the monthly evolution of hydro generation in Spain from 2014 to 2018. It can be seen that during one year, the period with more generation are the first months of the year.

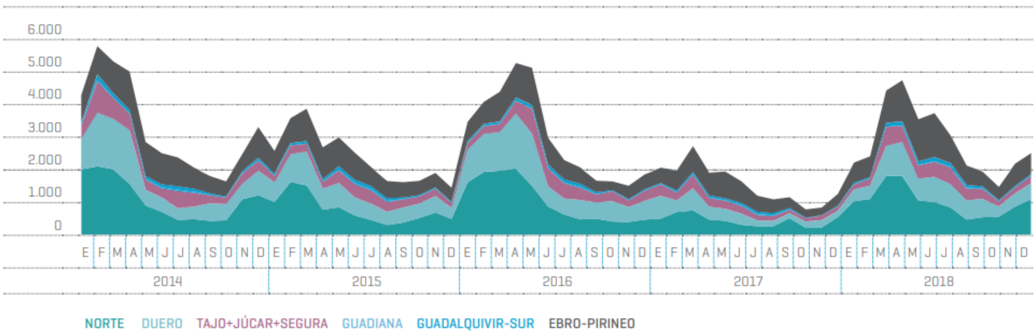

Figure 39: Hydro generation in GWh. Month evolution. Source [32]

One of the main advantages that this technology presents (compared to the rest of renewable sources) is its programmability, which is evident when observing Figure 40 showing how the greater contribution of this technology coincides with the peaks in demand in the morning (around 10:00 h) and in the evening (around 22:00 h).

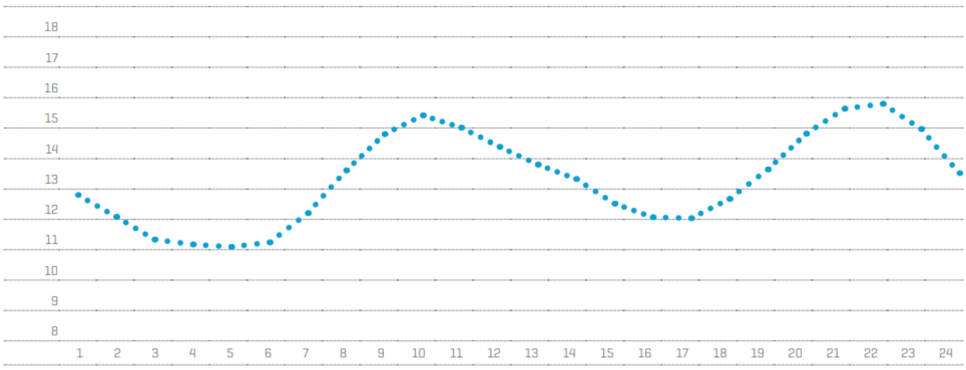

Figure 40: Average hourly profile of hydro over total generation in 2018. Source [32]

Concerning communities, in Figure 41 we can see that Castilla y León is the region with the most installed hydro power (almost 26% of the national hydro power) having exclusively the second most important basin on the peninsula, the so-called Duero. On the other hand, the North basin (the most important and that one running along the Cantabrian coast and much of Galicia, places the latter community in second position in hydraulic capacity, with almost 22% of the total. Thus, five communities account for 80% of the total installed capacity: Extremadura, Cataluña, Aragon and that those ones aforementioned.

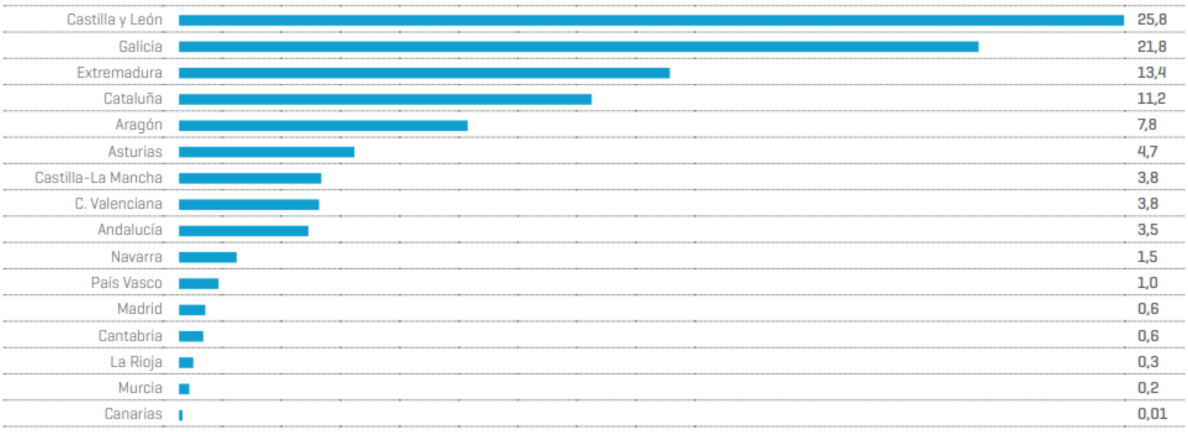

Figure 41: Installed hydro power of each community over national hydro power. Source [32]

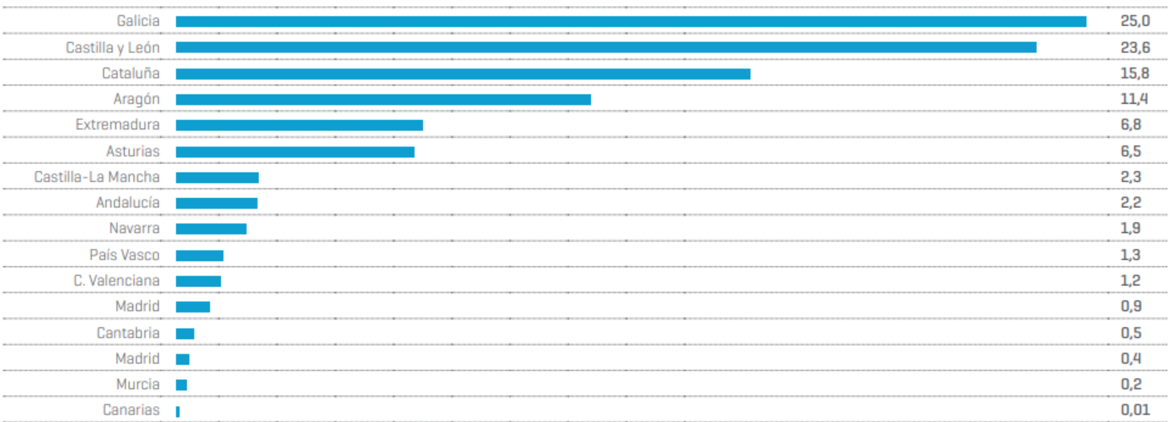

Figure 42: Hydro generation of each community over national hydro generation. Source [32]

Compared to the rest of European countries, in 2018 Spain has occupied the seventh place in energy generated with this technology. However, it is situated below the half, in nineteenth position, in terms of participation of the hydraulics over the total generation, see Figure 43 below.

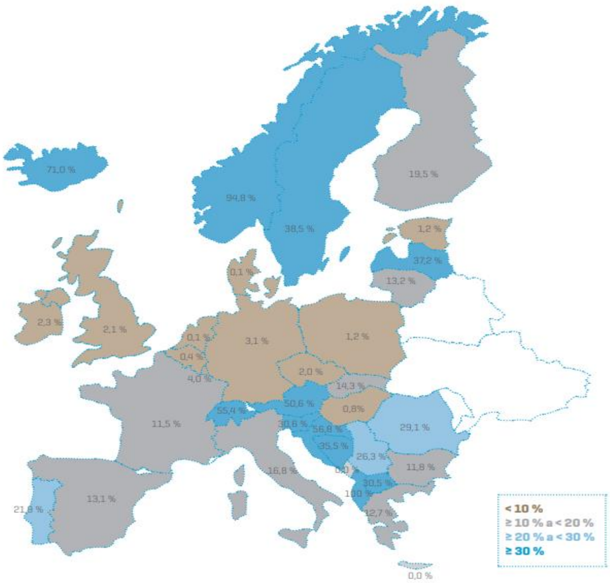

Figure 43: Hydraulic generation over total generation in ENTSO-E member countries. Source: [32]

2.3.2.3. Solar

Solar is the third renewable electrical generation source in Spain with 7018 MW of installed capacity and 12183 GWh of generation in 2018. This corresponds to 4.7% of the total energy generate nationwide and 6.7% of the total national installed capacity. Figure 44 shows the annual evolution of solar installed power in Spain.

<u>Distribution of installed solar capacity in Spain</u>

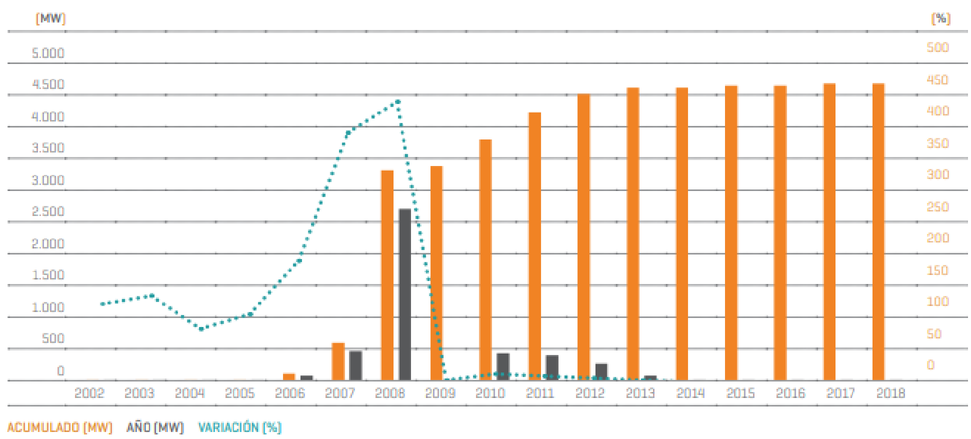

Figure 44: MW of installed Solar power. Annual evolution. Source [33]

As the same way as wind power, solar installed power has stabilized over the last five years after a long path of continuous growth. The highest increases are recorded in 2007 and 2008, with the latter reaching a record of new 2733 MW. This growth continued until 2013 with an average of over 250 MW installed each year.

Figure 45 shows the Spanish solar power installations at the end of 2018. Those ones with more installed power were: “Castilla la Mancha”, “Andalucía”, “Extremadura” and “Castilla y Léon” with more than 400 MW.

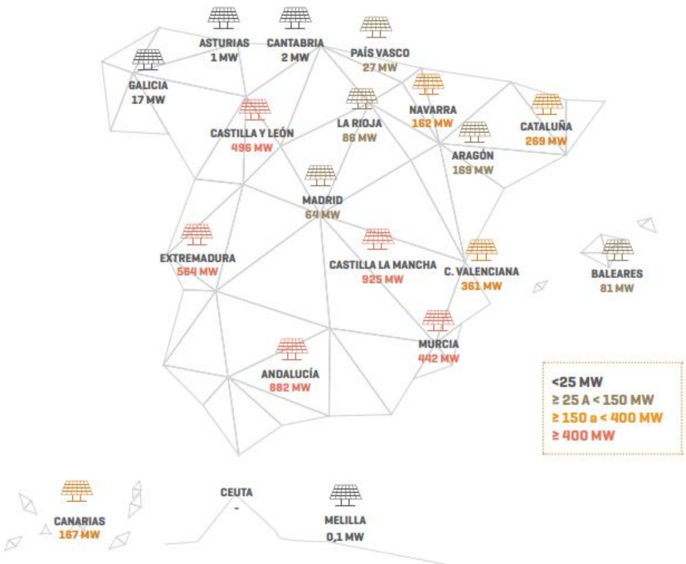

Figure 45: Installed solar power in Spain at the end of 2018. Source: [32]

As it can be seen also in Figure 46, “Castilla-La Mancha” is the region with more photovoltaic solar power installed with almost 20% of all the national power, followed by Andalusia with 18.7% and a little further away through “Extremadura” and “Castilla y León”. These four communities together account 61% of the national installed solar power in Spain. On the other hand, specifically outstanding are the regions on the Cantabrian coast, all of them below 1% of the total national power.

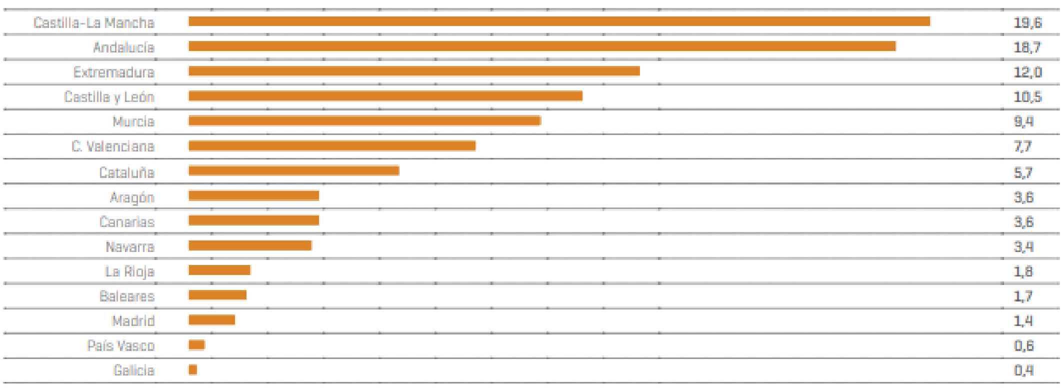

Figure 46: Percentage of photovoltaic installed solar power of each region over the national photovoltaic capacity until 31/12/2018. Source: [32]

Distribution of generated solar capacity in Spain

Looking to Figure 47, solar generation in Spain the installed increased constantly from the early 2000s until 2012, but as well as wind power, from then onwards only little additional energy has been generated with a significant decrease in 2018.

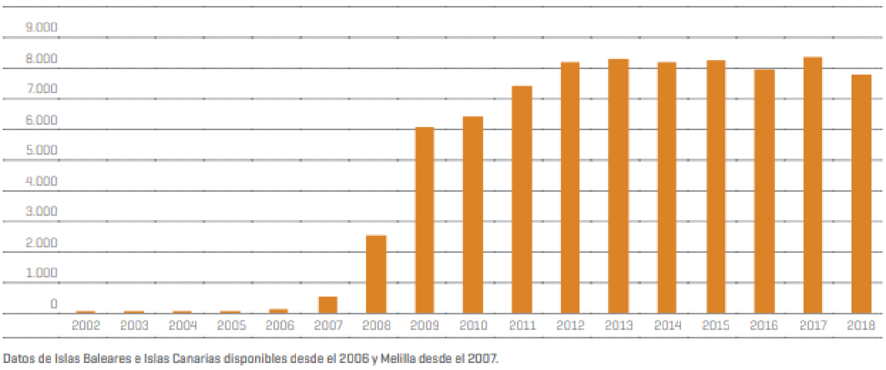

Figure 47: Annual evolution of solar generation. [GWh]. Source: [32]

As it can be seen also in Figure 48, "Castilla-La Mancha" is the region with more photovoltaic solar generation with more than 20% of all the national solar generation, followed by Andalucia with 19% and a little further away through "Extremadura" and "Castilla y León". These four communities together account 62.8% of the national solar generation in Spain. On the other hand, specifically outstanding are the regions on the Cantabrian coast, all of them below 1%.

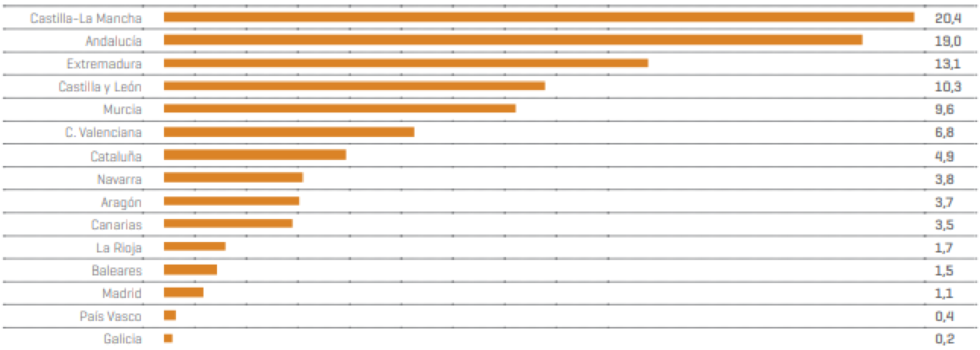

Figure 48: Percentage of solar generation over total national solar generation at the end of 2018. Source: [32]

As it can be seen in Figure 49, the summer months are these periods with higher solar contribution mainly due to the greater availability of the sun in those months. During 2018, the monthly maximum of production was recorded in July which was 1.9% higher than the previous year. Seasonality is an important factor in this technology and greatly conditions its production throughout the year. From May to August the generation presents quite similar values, while it falls to almost half in the months of November to February.

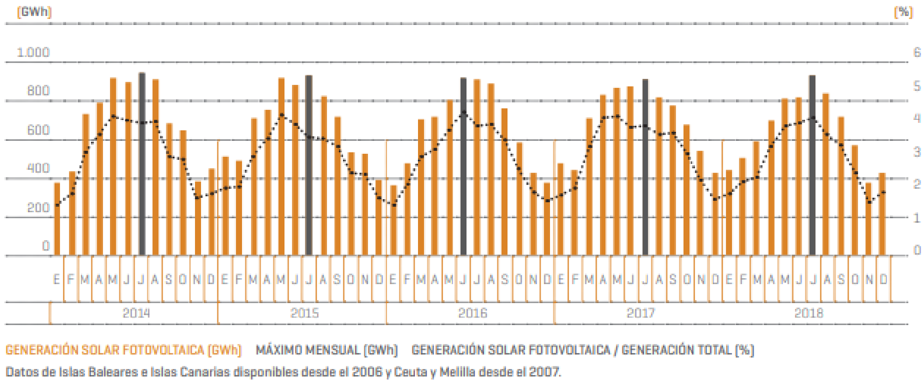

Figure 49: Solar generation, monthly maximums and participation on total generation. Source: [32]

When observing Figure 50 it can be seen that the contribution of this technology happens only with the hours of the day (from 8:00h to 21:00h).

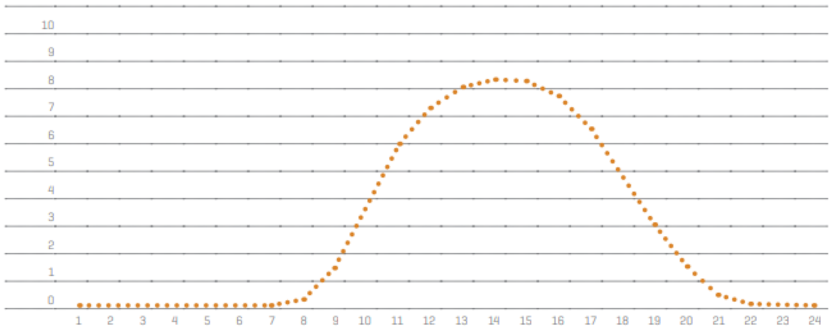

Figure 50: Average hourly profile of solar photovoltaic generation over total generation in 2018. Source: [32]

Compared to the rest of European countries, as it can be seen in

Figure 51, in 2018 Spain has occupied the fifth place in energy generated with this technology behind Italy, Greece, Germany and Belgium. However, it is situated in second position in terms of ratio generation over the total generation.

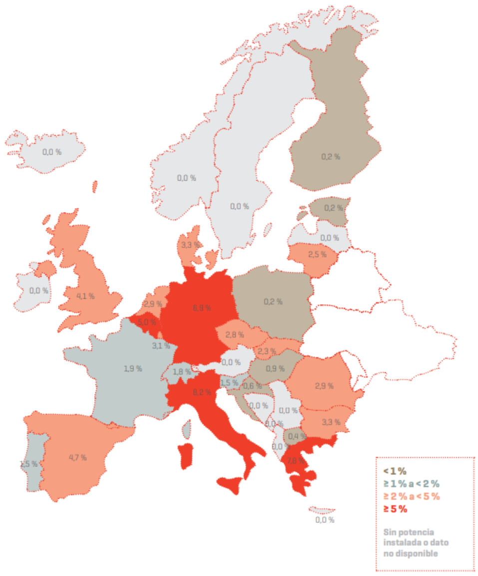

Figure 51: Solar generation over total generation in ENTSO-E member countries. Source: [5]

3. Market structure

3.1. The Italian Electricity Market

As explained in the previous chapter, in 1999, the Decree n.79 known as Bersani decree, set out the process of liberalization of the energy sector which would led to the current market organization structure. It laid the foundations for the creation of an organized wholesale electricity market (96/92/EC) into the national legislation, commonly known as the "*Borsa Elettrica*", or IPEX (Italian Power Exchange) in response to two specific needs:

i. Promote, according to criteria of neutrality, transparency and objectivity, competition in the production and sale of electricity;
ii. Ensure the economic management of adequate availability of dispatching services.

The sector changed from a monopoly to a complex mechanism, with a plurality of parties competing to offer services and products to customers rather than users. Currently the main parties involved in the market are:

i. production companies;
ii. the Transmission Grid Operator (TSO): Terna S.p.a
iii. Distribution System Operators (DSO);
iv. Market Operators active in energy trading and supply (MO);

IPEX enables producers, consumers, and wholesale customers to enter into hourly electricity purchase and sale contracts. Market participants can connect to an electronic platform through internet and enter into on-line contracts under secure access procedures based on digital certificates.

The task of organizing and managing the electricity market is set up to the "*Gestore dei Mercati Elettrici S.p.A*" (GME) which, operating according to the aforementioned criteria, also guarantees, the security of trade and the matching of the demand and supply of electricity.
The Power Exchange is the virtual exchange location where the final price of energy. This price, also called *spot price*, is determined by the meeting between the quantities of electricity demanded and offered by operators who have been admitted to participate. It is also the place where "*Terna S.p.a*" obtains the necessary resources to provide for the dispatching of electricity in the national territory. IPEX also represents the physical market where the electricity injection and withdrawal programs are defined in (and from) the grid for each connection point.

However, it should be noted that the Power Exchange is not a mandatory market, as operators can conclude contracts for the purchase and sale of electricity even outside the same, through the so-called "Bilateral Contracts" or also known as "Over the Counter" (OTC), through which certain quantities of electricity are sold for a certain time horizon.

According to the TIDME ("*Testo Integrato della Disciplina del Mercato Elettrico")* [34], IPEX is divided into:

i. The Spot Electricity Market (“*Mercato elettrico a pronti*” - MPE): where most of the daily electricity trading transactions are performed.
ii. The Forward Electricity Market *(“Mercato elettrico a termine dell’energia elettrica”*- MTE): is the virtual location where the negotiation of energy contracts takes place with the obligation of delivery and withdrawal.
iii. The Platform for physical delivery of financial agreements traded on IDEX (“Italian Derivates Energy Exchange) (“*Consegna Derivati Energia”* - CDE*)*

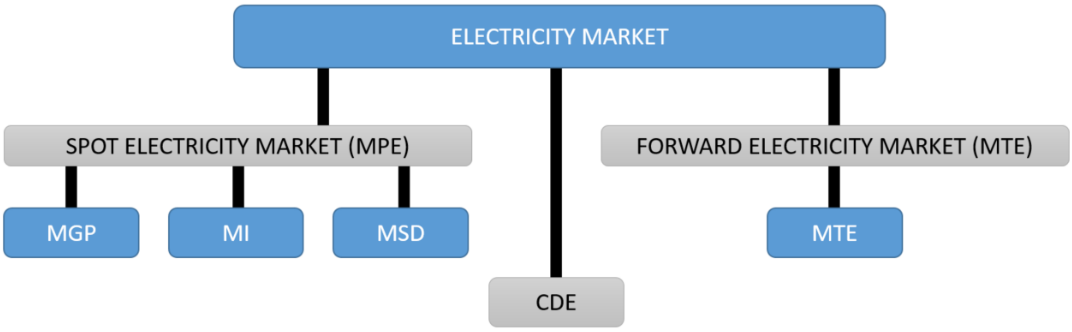

Figure 52: Structure of the Italian Electricity Market. Source: [3]

The majority of electrical energy in IPEX is traded through the spot market, in particular in MGP.

3.1.1. Market zones

The electrical system is divided into subsets of transmission grids defined as zones. These zones are defined to consider physical limits created simply due to geographic limitations and respectively connecting few lines. By doing so, system security is enhanced.
This electricity system thus is a very special approach only used in Italy. Is divided into market zones, groups of geographical and virtual areas whose energy price is:

i. For generators/sell-offers differentiated according to the area (also called zonal price): determined for each hour by the intersection of the demand and supply curves and is different from zone to zone when transmission capacity limits are saturated.
ii. For consumers, however, consumers/buy-offers face always one National Single Price: the “*Prezzo Unico Nazionale”* – PUN, which simply corresponds to the average of the zonal sale prices, weighted with total purchases.

Terna S.p.A divides the network into zones on the basis of these criteria:

- Transport capacity between the zones has to be adequate. Considering the most frequent operation situation on the basis of the forecasts made on the market and implementing the adequate programs of injection and withdrawal.
- The programs execution of injection and withdrawal does not have to cause congestions within each zone considering the predictable operating situations (also known as the “copper plate” assumption);
- The location of injections and withdrawals, including the potential ones, within each zone does not have to have a significant influence on the transport capacity between areas.

Currently, the national transmission grid can be summarized as follows:

i. Six geographical zones: North, Center-North, Center-South, South, Sicily and Sardinia.
ii. One virtual zone representing constrained zones, those consisting only of generating units: Rossano.
iii. Nine neighboring countries (so-called virtual zones): France, Switzerland, Austria, Slovenia, Malta, Montenegro, Corsica, Corsica AC and Greece.

The production of this last virtual area is subject to constraints for the safe management of the electrical system, consisting only of production units whose interconnection grid is lower than their installed capacity

Figure 53: Zonal division of the Italian territory. (GSE)

To identify and remove any congestion that may be caused by scheduled injection or withdrawal, GME uses a simplified map of the real grid. The map only shows the most significant transmission limits that are those between national geographical zones, neighboring countries or foreign zones and constrained zones. In particular, upon the closure of MGP sitting, the algorithm run by GME uses the bids presented to find the supply-demand balancing, then calculates the results in terms of power flows between different zones. Whenever these results exceed the constraints, different prices are obtained on the two sides of the congestion. These are commonly known as zonal prices. With no congestions in place the zonal prices however do not defer, and hence one common price is in place.
Figure 54 shows the topology of interconnection between the geographical and/or virtual zones of the zonal structure in force starting from 1st January 2019:

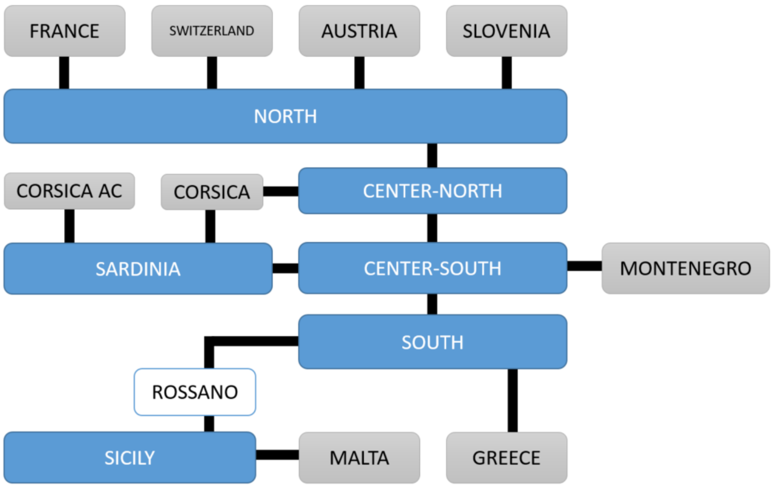

Figure 54: Interconnection between zones. Source [2]

A zonal market allows for Terna's costs reduction in the MSD to supply the necessary resources. Also ensure the compatibility of energy flows programmed and the safety of the system with the actual system constraints. This is an important element, especially if we consider the critical conditions of competition in MSD. Without a division of the market, a national uniform price might align to the values of the expected price in the area with higher prices, with consequent negative impact on prices paid by final customers.

Interconnections between zones are really important especially for efficiency. This is why it is very important to develop them constantly. The realization of new electricity grids or the upgrading of the existing ones aims to speed up the connection of the new facilities and to increase the transport capacity between zones, in order to solve congestion.

3.1.2. The Spot Electricity Market (MPE)

According to TIDME [34], the Spot Electricity Market consists of:

i. **Day-Ahead Market** ("*Mercato del Giorno Prima"* – MGP), which hosts most of the electricity sale and purchase offers exclusively for the next day.
ii. **Intra-Day Market** ("*Mercato Infragiornaliero*" – MI), allows market participants to modify the injection/withdrawal schedules defined in the MGP by submitting additional supply offers or demand bids.
iii. **Ancillary Services Market** ("Mercato del Servizio di Dispacciamento" – MSD), where Terna S.p.A procures the dispatching services needed to manage, operate, monitor and control the power system (relief of intra-zonal congestions, creation of energy reserve and real-time balancing).

The time sequence of the Spot Electricity Market in Italy is illustrated in Figure 55:

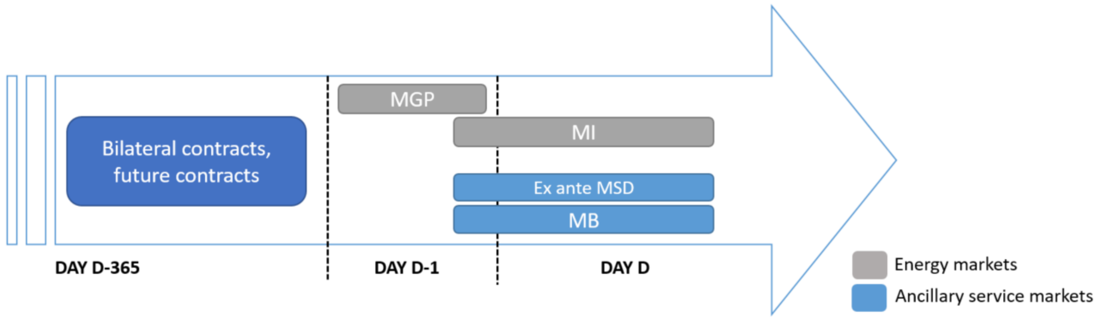

Figure 55: Time sequence of the Spot Electricity Market (Own elaboration)

3.1.2.1. Day-Ahead Market

The MGP hosts most of the energy sale and purchase transactions and is the place where hourly energy blocks are exchanged for the next day. It is a market organized according to the model of the implicit auction for the purpose of wholesale energy: Energy prices and quantities are exchanged as well as injection and withdrawal programs for the following day. In the purchase and sale contracts the GME operates as a central counterparty for market operators (manages the market platform), thus ensuring the successful outcome of the transaction and eliminating the counterparty risk [34].

The products traded on the MGP are physical contracts with obligation of physical supply. But participation to MGP is optional. The market is organized in 24 hourly bids. The MGP sitting opens at 8.00 of the ninth day before the day of delivery and closes at 12.00 of the day before the day of delivery. The results are published until 12.55 of the day before the day of delivery. Therefore, MGP is an auction market and not a continuous-trading market[3]. During the opening period of the session, participants can submit bids/asks where they specify the quantity and the minimum/maximum price at which they are willing to sell/purchase. Supply offers and demand bids must be consistent with the injection or withdrawal capabilities of the offer points to which they refer. The price or quantities must not be negative and the offers may also not specify any purchase price expressing, in this case, the operator's willingness to purchase energy at any price. Bids/asks are accepted after the closure of the market sitting based on the economic merit-order criterion and taking into account transmission capacity limits between zones. The market algorithm controls that the overall generation equals expected demand and that the energy flows do not violate the limits of any line interconnecting different zones previously described (section 3.1.1). As explained before, if there are no congestions, the price is the same in all the zones, otherwise the market is split in two or more zones, with respectively different prices.

At this point, MGP sitting results comprise:

- The production and withdrawal schedules for all the market participants, according to the respectively accepted bids;
- The market clearing price in each zone p_z for each hour of the day D, used to value the power injection quantities (injections are valued to the respective zonal price);

- A single national price (PUN) used to value the power withdrawal quantities in each geographical zones, equal to the average of zonal prices weighted by the total demand in each zone Q_i

$$PUN = \frac{\sum_i (P_i \cdot Q_i)}{\sum_i Q_i}$$

Referring again to section 3.1.1, all supply offers and the demand bids pertaining both to pumping and consuming units belonging to foreign virtual zones and accepted in the MGP are valued at the respective zonal price of the adjacent physical zone. Otherwise, the accepted demand bids pertaining to consuming units belonging to Italian geographical zones are valued at the PUN [3].

Figure 56 shows the structure and time sequence of the MGP:

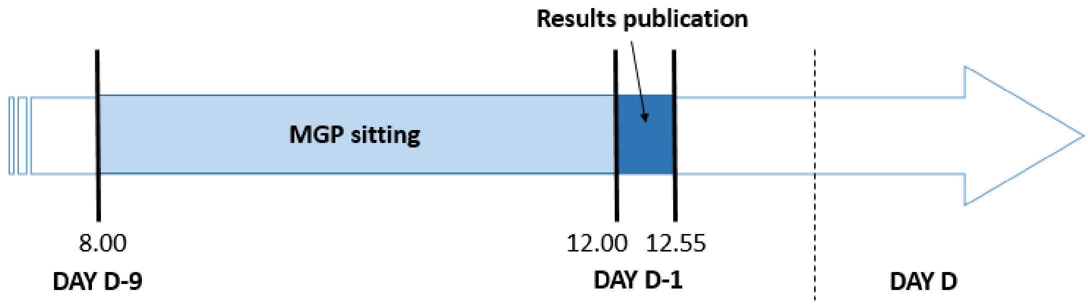

Figure 56: MGP structure (Own elaboration)

3.1.2.2. Intra-Day Market

The Intra-Day Market (MI) substituted the Adjustment Market in 2009 and was created to allow the market parties to update their commercial position, after the MGP clearing. In fact, MI allows updating the supply and demand schedules by placing new bids. Also in the electricity purchase and sale contracts stipulated on the MI market, GME operates as a central counterparty.

The MI is organized in seven sessions: MI1, MI2, MI3, MI4, MI5, MI6 and MI7. The sessions are organized occurring between the day (D-1) and day D in the form of implicit auctions of electricity, with different closing time and in sequence. Through these auctions, participants may better check the status of power plants and update the withdrawal schedules of consuming units, taking into account more up-to-date information about the status of their own power plants, the electricity requirements for the next day and market conditions. The sitting of the MI1 takes place after the closing of the MGP. It opens at 12.55 of the day before the day of delivery and closes at 15.00 of the same day. The results of MI1 are published within 15.30 of the day before the day of delivery. The sitting of the MI2 opens at 12.55 of the day before the day of delivery and closes at 16.30 of the same day. The results of the MI2 are published until 17.00 of the day before the day of delivery. For MI3, the sitting opens at 17.30 of the day before the day of delivery and closes at 11.45 of the same day. The results are published within 00.15 of the day of delivery. MI3 and next sessions (MI4, MI5, MI6 and MI7) are following one on the other with later 4h difference. To clarify, all sitting opening and closure times are listed in Figure 57.

MI is not at all a real-time market as the start of delivery of each session is, in general, 4h after gate closure (except for MI1 and MI2). The sessions of the MI the buy/sell offers are selected based on the rules that are consistent with those of the MGP. Nevertheless, unlike in the MGP, the PUN is not calculated and all purchases and sales are valued at the zonal price: this affects the consumption/offer units and is done to avoid arbitrage of the zonal and PUN prices.

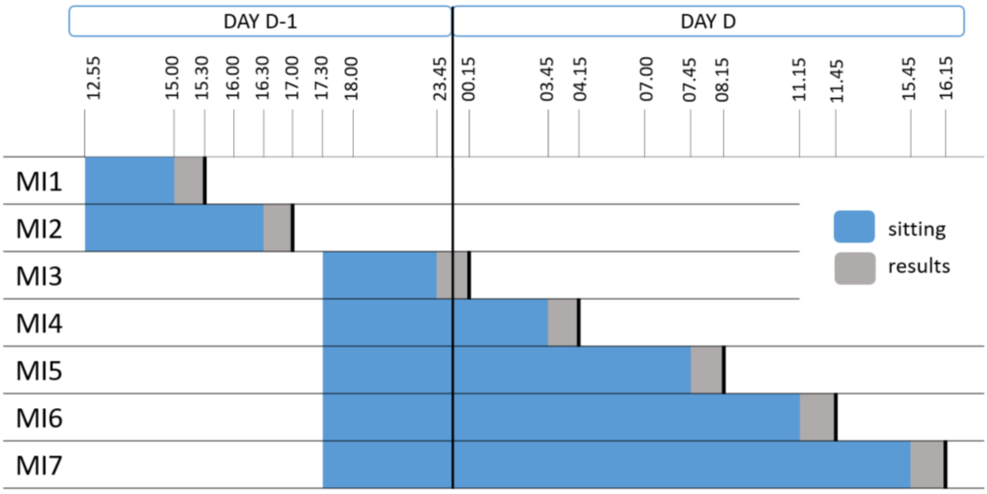

Figure 57: Time sequence of intraday market sessions. Source: [3]. *(Own elaboration)*

3.1.2.3. Ancillary Services Market (MSD)

The electricity supply service must be carried out in compliance with adequate standards of safety, reliability, quality, continuity and efficiency. That is achieved through the action of a figure in charge of managing and controlling the transmission system. Instantaneous balance between demand and generation has to be ensured, respecting the operating limits of voltage, current, frequency… even in conditions of large perturbations. Therefore, the system operator has a control of both voltage and frequency and also the appropriate resources to be used, even in hard situations. In Italia the supply of these resources take place through the Ancillary Services Market.

The Ancillary Services Market (MSD) is the venue where the TSO procures the resources required for managing and monitoring the system relief of intra-zonal congestions, creation of energy reserve and real-time balancing. Is organized by GME but Terna acts as a central counterparty and approves purchase and sale contracts with the aim of obtaining the resources for power system control (i.e. re-dispatching activity to comply with grid constraints).

In general the ancillary services market trades and remunerates the following services:

- **Congestion management**: these resources are used with the aim of eliminating the congestion on the network generated by the updated cumulative injection and withdrawal programs.
- **Secondary reserve** (frequency control): has the purpose of offset the gap between demand and production of the national system, thus bringing the power exchange

at the national border to the correct values, and contributing, as a result, to the reestablishment of the European frequency. Is considered the most valuable resource, because it is automatically activated in a few seconds.
- **Tertiary reserve**: in order to establish appropriate margins in relation to the minimum or maximum power in the programs following the MSD.
- **Real-time balancing**: in order to ensure the maintenance of the balance between withdrawals and injection of electricity, congestion resolution and correction of secondary reserve margins. Balancing service is used by obtaining resources of the tertiary reserve and accepting the offers presented in real time on the MSD.

While there are other not remunerated services (until now) and hence not traded on any market:

- Primary frequency control;
- Primary voltage control;
- Load shedding;
- Black-start capability;
- Secondary voltage control.

The market in question is organized in two phases that take place in multiple sessions: a programming phase (ex-ante MSD) and Balancing Market (MB), as provided in the dispatching rules.

i. MSD Ex-ante

The MSD ex-ante, takes place right after MGP and still in day D-1. In particular, it consists of six scheduling substages: MSD1, …, MSD6. The sitting for bid/ask submission into the ex-ante MSD is a single one: it opens at 12.55 of the day before the day of delivery and closes at 17.30 of the same day. The results of the MSD1 are published within 21.45 of the day before the day of delivery. GME notifies Market Participants of the individual results of the MSD2 session (as specified in the dispatching rules) concerning the bids/asks accepted by Terna within 2.15 of the day of delivery. The notification of the results of the next sessions (MSD3, MSD4, MSD5, and MSD6) are following one on the other with later 4 hour difference (see Figure 58) [3].

Currently in Italy each MSD Ex-ante session where are obtained the reserve margins necessary for the safe management of the system, follows a corresponding session (auction) of the Intraday Market. That is, Terna uses MSD ex-ante to “correct” or at least building upon the MI [35]. Demand bids and supply offers are accepted by Terna in order to relieve residual intra-zonal congestions and to create reserve margins for system operation. It is important to mention that unlike MGP and MI, accepted offers of both ancillary service markets, MSD ex-ante and Balancing Market are remunerated at the price offered (pay-as-bid). So, there is no longer a fix zonal price that all generators would receive equally.

ii. Balancing Market (MB)

The Balancing Market (MB) is the venue where ancillary services offers (upward and downward), made available for periods of day D, are selected by Terna in order to guarantee the real-time balancing of the power system. In this market there is no “clearing” of the market ahead of time, but it’s a real-time market. The MB takes place in six sessions, during which Terna selects service offers referring to groups of hours during the day. The first session of the MB takes into consideration the valid bids/asks that participants have submitted in the previous ex-ante MSD session. For the other sessions of the MB, all the sittings for bid/ask submission open at 22.30 of the day D-1 (and anyway not before the results of the previous session of the ex-ante MSD are known) and close 1 hour and a half before the beginning of the actual session, in which then offers are accepted and need to be executed in real time.

Figure 58 shows the time sequence of both ancillary services markets, MSD ex-ante and MB:

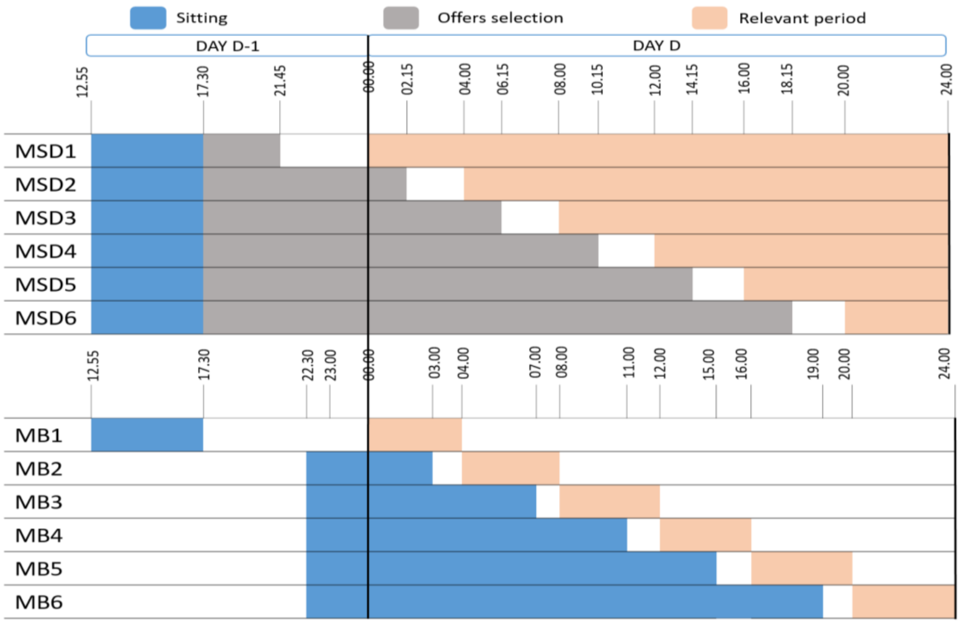

Figure 58: Time sequence of MSD market sessions. (Own elaboration)

3.1.3. The Forward Electricity Market (MTE)

Market players, other than presenting bids on the spot market, can sign bilateral contracts (OTC) or participate in the forward electricity market. The venue for the latter kind of negotiation in the electricity sector in Italy is called *“Mercato a Termine dell’Energia*” – (MTE). Forward contracts imply the delivery and withdrawal obligation on a future date with GME acting as a central counterparty. Any market player can decide to sell or purchase blocks of energy in a future date. Trading in the MTE takes place on a continuous basis.

The forward contracts that can be signed in MTE are standardized, meaning that both the quantity and the time period cannot be varied freely. The energy blocks tradable on MTE consists of 1 MW power multiplied for a different number of hours in the chosen period, according to the definitions:

- Base-load, corresponding to all the hours of each day in the contract;
- Peak-load, corresponding to the hours between 9 and 20 in each day in the contract, Saturdays and Sundays excluded.

Participants enter bids/offers where they specify the type and delivery period of the contracts, the number of contracts and the price at which they are willing to purchase/sell. GME organizes an order book (for each type of contract ad each delivery period) where bids/offers are ranked by price offered (pay-as-bid). Sessions are held between 9.00 and 17.30 of market days, with closing time anticipated at 14.00 on the second-last day of the month. For multi-month products, the cascading rule applies, i.e. the same offer is repeated for each month until the end of the period. For each trading session and contract, GME publishes, among other information, the total volume traded, the reference price of the session and the minimum/maximum prices [3].

3.2. The Spanish electricity market

On the mainland of Spain, in November 1997, Electric Sector Law 54/1997 was published: it defines the Spanish Electricity Market and related institutions. The Spanish Electricity Market started up in January 1998 and this reform had the typical triple objective to guarantee:

i. the supply of electricity;
ii. the quality of this supply;
iii. this process at a lower cost.

It establishes a fully competitive framework for the generation of electricity while, at the same time, it defines a transient process for the liberalization of retail supply. In the Spanish Electricity Market, the market mechanisms are centralized and managed by an entity known as *"Market Operator"* (MO). To play this role, a new institution was created: the "Compañía *Operadora del Mercado Español de la Electricidad"*; this institution is in charge of the set of short-term market mechanisms through which the great part of the physical transactions take place, manage the generation offers and demands, and the "*Comisión Nacional de la Energía*" (National Energy Commission), which will ensure the system's free competition.This law creates the necessary tools to liberalize the market: separating regulated activities, such as transport and distribution, from unregulated activities (also called free activities), such as generation and commercialization, in addition to the entry of "*Red Eléctrica de España*" – (REE) into the stock market and privatizing certain parts of it.

The electrical market aims to supply the entire society with electrical energy. In the production of electricity, different agents participate and interact with each other carrying out the activities previously mentioned: generation, transport, distribution and commercialization. Since the amount of electricity consumed and generated must always be the same, all agents must interact with great coordination. This demonstrates the character of the electricity supply system, as all these agents are involved for each moment of consumption.

Figure 59 shows the structure of the Spanish electrical market:

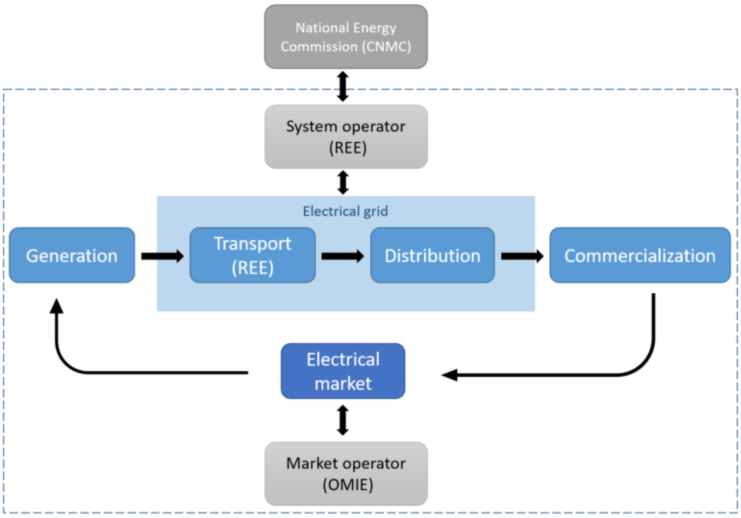

Figure 59: Electrical market structure. (Own elaboration)

Regarding generation, there are two types of producers:

i. Special regime producers: are those that generate electricity through renewable and cogeneration energies.
ii. Producers in ordinary regime are all others.

In this country, the transport is carried out by the REE. Previously there were different companies responsible for supplying electricity in each region, being the connection between regions really poor. Therefore, for reasons of efficiency, it was decided to nationalize the high voltage grid and make a single entity, the REE, responsible for managing the transport throughout the national territory under a monopoly regime. Distribution, although being a regulated activity such as transport, is carried out by private companies to which the State recognizes costs that, subsequently, are paid by consumers in the regulated part of the electricity tariff. In Spain the main distributers of electricity are: "*Endesa*", "*Iberdrola*", "Naturgy" (previously "*Gas Natural Fenosa*"), "*EDP*" and "*Viesgo*", which form the AELÉC association (formerly known as UNESA). Figure 60 shows the Spanish area covered by each distributor:

Figure 60: Map of distribution areas. Source: [34]

In the past, distribution companies were also trading companies but now, with the liberalization of this market and due to the separation of regulated and liberalized activities, they can no longer carry out any type of activity related to the supply or production of electricity. Regarding commercialization, companies acquire electricity in the wholesale market and sell it in the retail market to the final consumer. Service provided by electricity traders must cover minimum quality condition as the continuity of the supply service, the quality and the relationship with the customer and the level of the product offered.

On liberalized market, the main traders that cover almost 90% of the supply are AELÉC association as it can be seen in Figure 61:

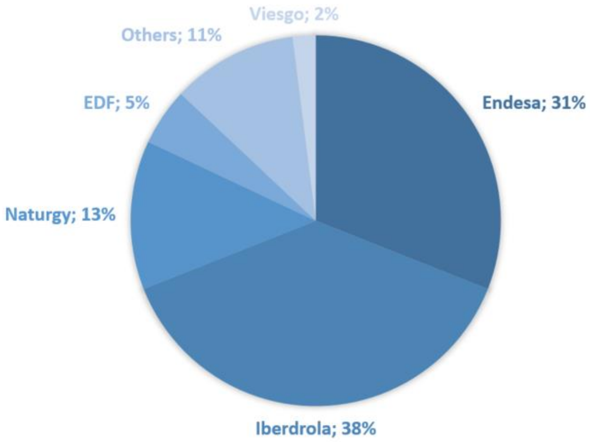

Figure 61: Free market traders. Source: [33] *(Own elaboration)*

The Spanish electricity market is clearly an oligopoly, as among five large business groups (AELÉC) control most of the electricity distribution and commercialization in the country. It is also worth mentioning other regulatory bodies and managers that ensure the correct system operation:

- "*Red Eléctrica de España*" – (REE), which acts as system operator and sole carrier of electricity. Has the purpose of ensuring the correct functioning of the system and guaranteeing supply continuity.
- "*Operador del Mercado Ibérico de Energía*" – (OMIE), acts as a market operator, managing the matching of energy purchase/sale offers in the daily and intraday market.
- *"Comisión Nacional de los Mercados y la Competencia"* – (CNMC), preserves and guarantees the correct functioning, transparency and effective competition within the electricity markets.

The following sections will explain the operation of the current electricity market in Spain.

3.2.1. Wholesale market (MIBEL)

In order to improve security of supply and economic efficiency, Spain and Portugal launched on July 2007 the all-Iberian Electricity Market (MIBEL). The MIBEL complements the previous mechanisms of the Spanish Electricity Market with a derivatives market and other new market mechanisms. This derivatives market has its own MO called "*Operador do Mercado Iberico de Energía – Pólo Português*" (OMIP) and the old Spanish market operator is renamed as "*Operador del Mercado Iberico de Energia – Polo Español*" (OMIE) and it is still in charge of the spot markets.

The wholesale electricity market is structured into:

i. The Forward Electricity Market
ii. The Spot Electricity Market that includes:
    a. Day-ahead market
    b. Intraday markets
        i. Intraday auction market
        ii. Intraday continuous market
iii. Market for adjustment services

As it can be seen in Figure 59 there are two key figures in this market:

i. The System Operator (REE): responsible for managing the deliveries associated with the purchase and sale of the agents and ensures that these deliveries are physically viable in the electricity network;
ii. The Market Operator (OMIE for Spain, OMIP for Portugal): which facilitates that transactions are carried out in a standardized manner and all agents have the same information.

The electricity market is a "pool" where agents are obligated to offer, to the Market Operator, all their available energy individually for each of their plants. Depending on the anticipation with which the purchase of electricity is made, we differentiate between spot market and markets with term delivery.

Figure 62 shows the time sequence of the Spanish wholesale electricity market.

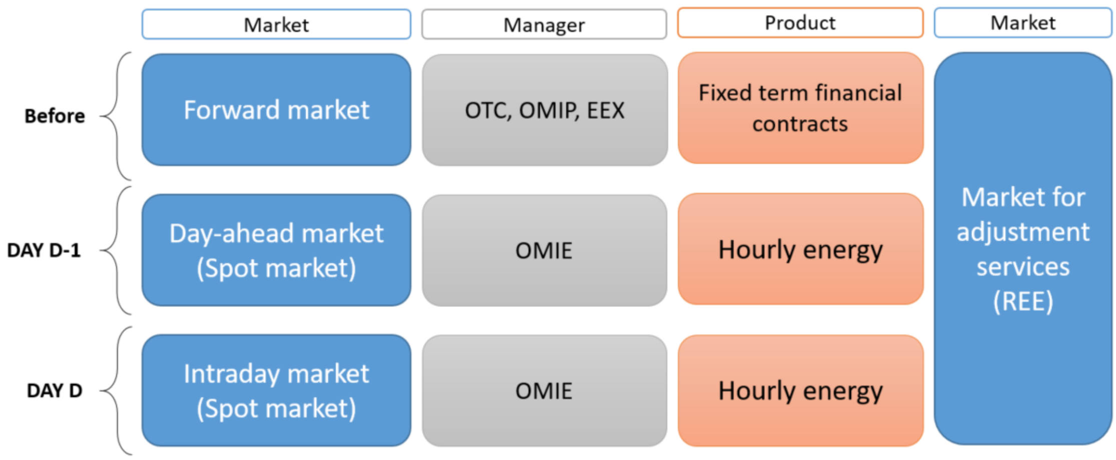

Figure 62: Sequence of the Spanish wholesale electricity market. Source: [36]. *Own elaboration*

3.2.1.1. The Forward Electricity Market

In this market, agents exchange purchase/sale contracts with delivery times exceeding 24 hours, being able to produce years, months weeks or days before the physical delivery of the energy. On the one hand there are the non-organized markets: the bilateral contract market and the "Over The Counter" (OTC) financial market, where parties negotiate directly with each other according to their needs without participation rules and where prices are set privately. On the other hand, there are organized markets: in which there are participation rules approved and managed by other entities. It is carried out through continuous trading, where the agents show their firm purchase/sale offers during a certain period so that the rest of participants can access to those offers.

i. The Spot Electricity market

i.1. Day-ahead market

From all the organized markets stands out the daily market, also known as day-ahead market or simply "*pool*" market, since its volume of transactions represents 80% of the electricity consumption in Spain and Portugal. This market aims to carry out electrical energy transactions by submitting selling and takeover bids for electrical energy on behalf of the market agents for the 24 hours of the following day. Electricity producers offer the amount of energy they are willing to generate the next day and the price at which they are willing to do it. For their part, traders and consumers communicate the amount of electricity they want and the prices at which they would be willing to buy it. In this way, it is set the amount of electricity to be generated/consumed and the price thereof.

This market is managed by OMIE, whose main goal is to ensure that the hiring is carried out in conditions of transparency, objectivity and independence. OMIE marries the supply and demand curves until the interconnection between Spain and Portugal is completely occupied. Their buying and selling bids are based on their economic merit and depending on the available capacity for interconnection between price zones. If, at a certain time of day, the capacity for interconnection between two zones is sufficient to allow the flow of electricity resulting from negotiation, the price of electricity at that time will be the same in both zones. If, on the other hand, interconnection at that time is maxed out, at that moment the algorithm for setting prices results in a different price in each zone. The mechanism described for setting electricity prices is called market coupling [4].

Once final results of daily market and bilateral agreements are obtained, they are sent to the System Operator for validation with perspective on their technical viability. This process is known as managing the system's technical limitations and ensures that the market results can be technically accommodated on the transportation network. As such, results from the day-ahead market may be altered slightly as a result of the analysis of technical limitations done by the System Operator, giving rise to a viable daily program. However, what is agreed in the daily market is unusual fulfilled, usually a series of mismatches appear. For example, if the wind increases, wind generators could offer more or may be the case that a generator has had a problem and cannot provide all the energy it has agreed upon. For this reason, in order to allow participants to adapt to these imbalances, is created the intraday market.

i.2. Intraday markets

The intraday markets allows market participants to adjust the day-ahead market's resulting schedule by submitting selling and purchase bids for energy, according to expected needs in real time. The intraday markets are currently structured into six bidding sessions in MIBEL's scope and a continuous cross-border European market, and they are carried out once the system operator has made the necessary adjustments after the day-ahead market so that the resulting schedule may be viable. Just like the day-ahead market, once this market is finished, the results are sent to system operators so that they can schedule balancing processes. Intraday markets allow agents to readjust their sale/purchase commitments up to four hours before real time. From that moment, there are other markets (market for adjustment services) managed by the REE in which the balance of production and consumption is ensured at all times.

i.2.1. The intraday auction market

The intraday auction market is currently structured into six sessions with programming horizons for each session, and it manages Portugal and Spain's price zones and the free capacity of interconnections: Spain-Portugal, Spain-Morocco, and Spain-Andorra, where the volume of energy and the price per hour are determined by the intersection of supply and demand.

The aim is to attend to adjustments to the Definitive Viable Day-Ahead Schedule, whose programming basis is the result of the day-ahead market, by submitting selling and takeover bids for electrical energy on behalf of market agents. As with the day-ahead market, intraday auctions follow the marginal pricing model and the market coupling model for the borders that it manages. The intraday auction market is currently structured into six sessions.

i.2.2. Intraday continuous market

Like the intraday auction market, the intraday continuous market, also called single intraday coupling (SIDC), gives market agents the chance to manage their energy imbalances.

The purpose of this market is to facilitate the trade of energy between different areas of Europe continuously and to increase the global efficiency of transactions on the intraday markets across Europe.

After the publication of the Definitive Viable Daily-ahead Schedule for the day (D+1) by the system operator, the opening of the negotiation of all contracts of the intraday continuous market for the next day (D + 1) will be made after the end of the first auction of the current day (D).

3.2.2. Retail market

There are a few consumers who buy the energy directly in the wholesale market, but the majority of the consumers do it through marketers, that have the function of buying energy from electricity generators, accessing to transportation and distribution networks to finally sell electricity to the final customer or international exchanges. The bill is established by the sum of two clearly different concepts:

- Energy costs: include, apart from the energy cost, the Adjustment Service cost, capacity costs and others with significantly less weight.
- Regulated costs, also called access tolls: include network costs (transport and distribution), subsidies for renewable energies, annual payments of electricity deficit and other costs with less weight. They suppose more than half of the bill for an average domestic client.

Retail market fixes the energy costs, since regulated costs are fixed by the Administration Currently, there are two types of retail market: regulated market and liberalized market. Both the same access charges and taxes will be paid in one market as in the other. The difference lies in the price charged for producing electricity and in the margin of the commercial management of the marketer. It is up to the user and their own characteristics to choose the type of market that best suits their conditions.

The billing modalities of liberalized markets and reference markets, although being similar, have significant differences: if a consumer has a contract with a marketer of the liberalized market, the rate they will pay will be the one agreed between each other. The other option is to be subject to one of the marketers of regulated market that will supply the electricity at the fixed prices. Liberalized traders are appointed by the Ministry of Industry. Currently these companies are the AELÉC group [37].

We are interested in assessing to what extent the penetration of renewable electricity sources has impact day-ahead wholesale electricity prices. The following sections will describe the data and the empirical model used.

4. DATA AND DESCRIPTIVE STATISTICS

The focus of our attention is the hourly wholesale price and hourly generation mix within different market zones. In particular we analyse data from Italy with its six different zonal markets and Spain with one national market.

Regarding Italy, we got the hourly price and total load consumed for each commercial zone, data provided by GME. We have obtained hourly generation mix from ENTSO-E, data also used by Terna [3][5]. Finally, we got gas price data from "European Energy Exchange AG" – EEX group [38]. Concerning Spain, in the same way as for Italy, we get hourly generation mix from ENTSO-E. The spot price for each hour of the day, instead, is obtained from ESIOS ("*Sistema de Información del Operador del Sistema"*) [39], database belonging to REE. Finally, we got gas price data from MIBGAS - "Mercado Iberico del Gas" [40]. Table 6 shows a brief description of the data used for both markets, as well as the source where we have got it. Data covers the entire year 2018 and includes the generation mix subdivided according to energy source of production: solar, wind, geothermal, hydro, hydro pumped-storage, coal, gas, among others. Zonal prices refer to Day-Ahead Market that hosts most of the electricity sale and purchase transactions.

As renewable generation highly depend on the time of the day, we see an additional value in focus our attention on analysing the impact using hourly data. In this way we went one step further to the analysis done by Clò et al. who said: "*We convert hourly data into daily-basis averaged hourly data. In this way we reduce excessive and unwanted noise that may arise from using hourly data (Gelabert et al. ,2011)* [41]" [1].

The main obstacle we have encountered have been obtaining hourly data for gas price: this variable has a very relevant role in the analysis since it is highly related to the electricity spot price (as it can be seen in Figure 64). By just finding daily data series, we have had to prioritize adding this variable to our approach and, in this way, convert all other data into daily, instead of using hourly data but having to exclude gas price (which would surely lead to not optimal or misleading results). For this reason we convert price, generation and load variables from hourly data into daily-basis averaged hourly data, calculated as follows[4]:

$$Daily\ data = \sum_{h=1}^{24} \frac{Zonal\ price_h}{24} \tag{1}$$

– [4] Example for zonal price. It is done in the same way for other data.

Table 6: Data description. Own elaboration

Variable	Explanation	Source for Italy	Source for Spain
ZMP	Daily average (zonal) electricity price [€/MWh]	[3]	[39]
LOAD	Daily average total load [MW]	[5]	[5]
SOLAR	Daily average generation from photovoltaics [MW]	[5]	[5]
WIND	Daily average generation from wind [MW]	[5]	[5]
RES	The sum of SOLAR and WIND [MW]	[5]	[5]
PGAS	Daily gas price [€/MWh]	[38]	[40]

Before proceeding with the analysis, below is presented the evolution of our variables in the entire year 2018 in North zone. First of all we present on Figure 63 the boxplot of our regression's variables.

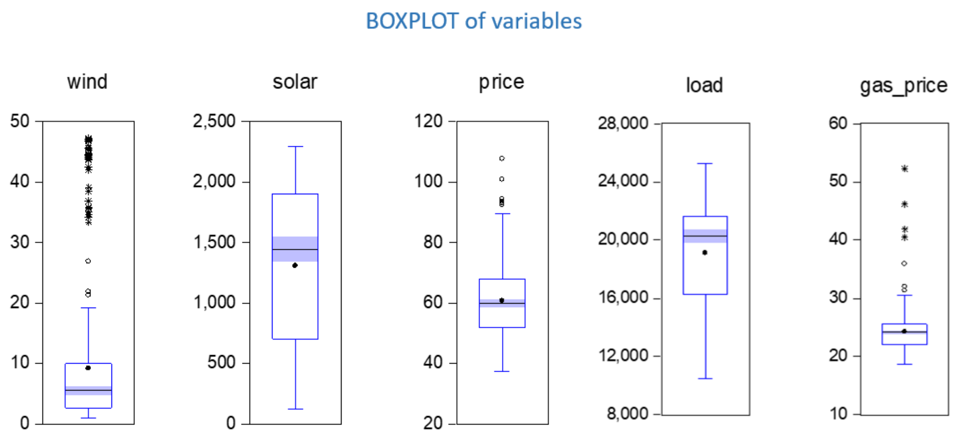

Figure 63: Boxplot of regression variables. North zone.

Figure 64 shows us the evolution of zonal market price and the price of gas for North zone. It can be seen that both variables follow a similar trend: i.e. in March there is a peak in both prices that falls again at the end of the month. After, from April to September prices increase regularly to then go back down gradually until the end of the year.

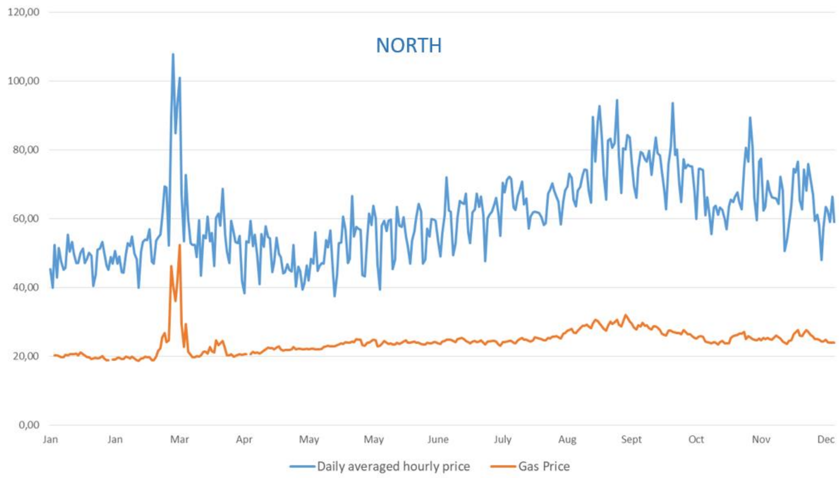

Figure 64: Evolution of zonal price and gas price for North zone. Own elaboration on [3] *data.*

On the graph of Figure 65 it is represented the annual evolution of solar generation for North zone. Also we have taken the month with the highest generation (June) and we graphed it separately to be able to see also the evolution of one month. If we take a look to solar annual generation, we note that months with the highest solar generation are those pertaining to spring-summer seasons: from April-May to August-September (when there's more sun on the territory).

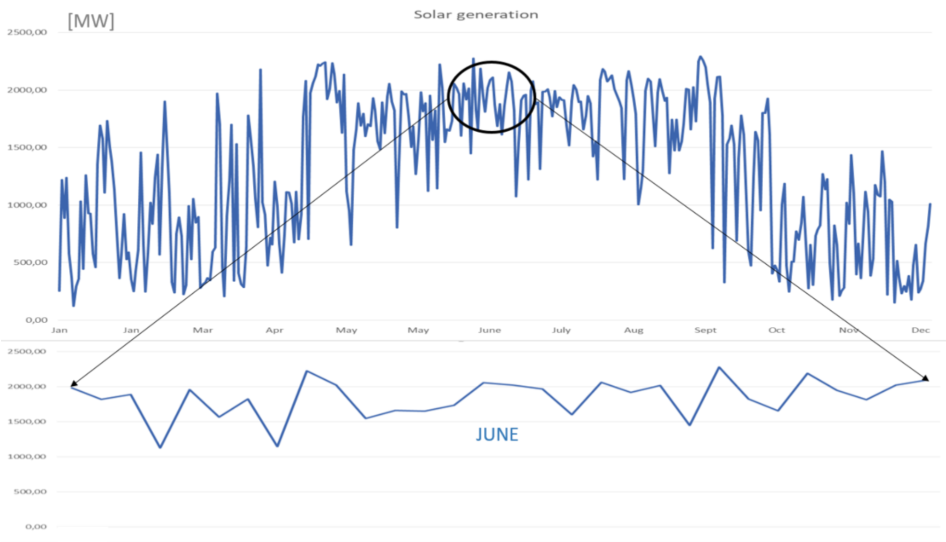

Figure 65: Annual and monthly evolution for SOLAR. North zone.

Regarding wind generation, we see that it is much more regular than photovoltaic generation. In this case, we want to compare two zones to confirm that the characteristic increase in North zone (around May and June) is somewhat punctual, since in general all zones behavior is quite regular. Say that in the Southern zones wind generation is much higher compared to Northern ones. (See Figure 66 and Figure 67)

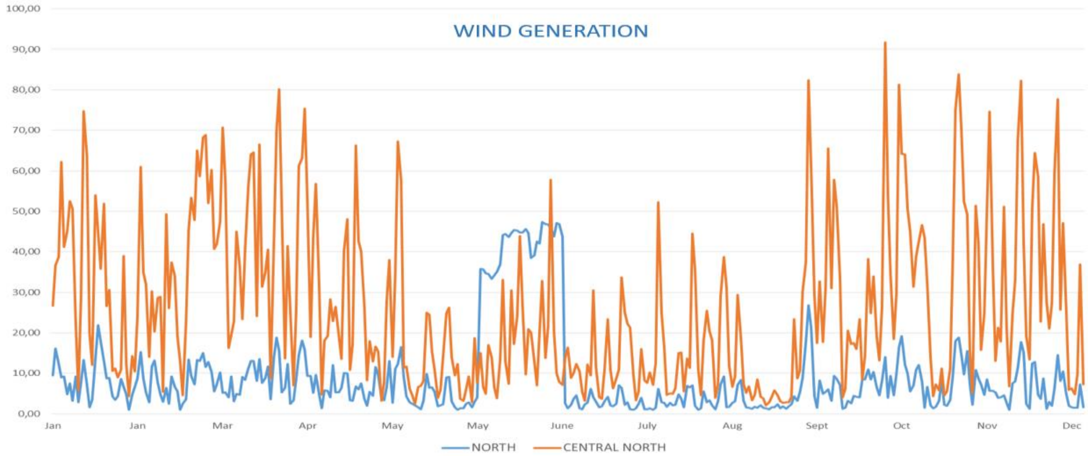

Figure 66: Wind generation evolution. Northern zones.

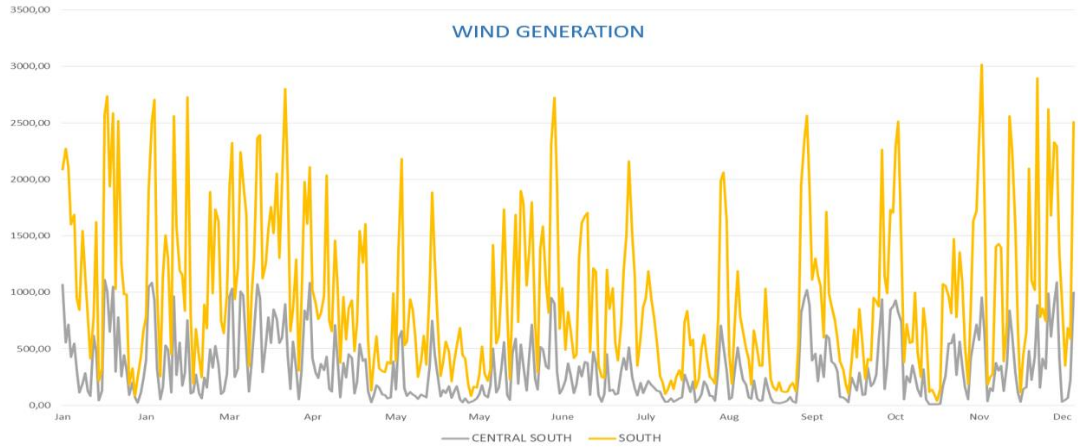

Figure 67: Wind generation evolution. Southern zones.

A brief overview of the overall methodology and approach used is:

- It is estimated the impact of renewable generation on electricity prices by modelling a linear regression with daily averaged price as dependent variable and using as explanatory variables the daily averaged electricity load, power generation mix by renewable energy source and the price of gas.
- To get the regression parameters, it is used Ordinary Least Squares (OLS) method, widely used in econometrics to estimate the parameters of a linear regression models.
- Before proceeding with the empirical analysis itself, it has been done some previous tests to check that our data fits with OLS assumptions (detaily explained in chapter 5).
- Once this previous tests done and data checked that is suitable for the analysis, one is able to run the regressions with the software: *EViews*.
- Then, in the same way as done for data series, residuals obtained after running our regressions fit OLS assumptions have to be checked. Otherwise pertinent changes should be made to get this fit.
- Finally, as long as the model satisfies the OLS assumptions for linear regression, one can rest easy knowing that estimates get the best as possible and one is able to reach into the pertinent conclusions.

5. METHODOLOGY

Regression analysis models the relationships between a response variable and one or more predictor variables. We use a regression model to understand how changes in the predictor values are associated with changes in the response mean. We can also use regression to make predictions based on the values of the predictors. There are a variety of regression methodologies that we can choose based on the type of response variable, the type of model that is required to provide an adequate fit to the data, and the estimation method.

5.1. Ordinary Least Squares (OLS)

In econometrics, Ordinary Least Squares (OLS) method is widely used to estimate the parameter of a linear regression model by minimizing the sum of the squared errors. This method draws a line through the data points that minimizes the sum of the squared differences between the observed values and the corresponding fitted values, also called predicted values. The error term indicates that the relationship predicted in the equation is not perfect, that is, the straight line does not perfectly predict dependent variable Y. The optimal line needs to be the one that minimizes the amount of error between predicted values and actual values. Specifically for each of the *n* observations in the sample, if one were to square the difference between the observed and predicted values of Y, and then sum these squared differences, the best line would have the lowest sum of squared errors.

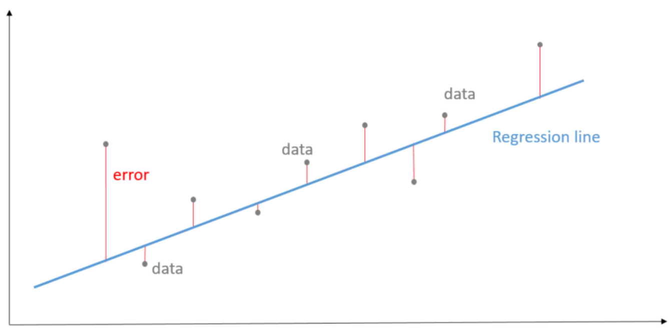

Figure 68: Ordinary Least Squares (OLS) method. Own elaboration.

5.1.1. OLS assumptions

Obtaining statistically valid results from the analysis depends on satisfying the following OLS assumptions [42]:

i. The linear regression model is “linear in parameters”: when the dependent variable Y is a linear function of independent variables (X’s) and the error term, the regression is linear in parameters (β) and not necessarily linear in X’s.

ii. There is a random sampling of observations:
   a. The sample taken for the linear regression model must be drawn randomly.
   b. The number of observations taken in the sample should be greater than the number of parameters to be estimated.

c. Independent variables should impact dependent variables (and not dependent variables impacting independent ones). In the latter case, OLS estimators are likely to be incorrect.
d. The error terms are random. This makes the dependent variable random.

iii. There must be no relationship between explanatory variables (X) and the error term (Ɛ). In other words, the expected value of the mean of the error terms of OLS regression should be zero given the values of independent variables.

$$E(\varepsilon) = 0 \tag{2}$$

iv. There is no multi-collinearity (or perfect collinearity): there should be no linear relationship between independent variables.

v. There is homoscedasticity and no autocorrelation: the error terms in the regression should all have the same variance (σ). If this variance is not constant (i.e. dependent on X's), then the linear regression model has heteroscedastic errors and likely to give incorrect estimates.

$$Var(\varepsilon) = \sigma^2 \tag{3}$$

a. The OLS assumption of no autocorrelation says than the error terms of different observations should not be correlated with each other. In other words, the covariance (*Cov*) between errors of different observations must be zero.

$$Cov(\varepsilon_i \varepsilon_j) = 0 \quad for\ i \neq j \tag{4}$$

vi. Error terms should be approximately normally distributed: this assumption is not required for the validity of OLS method, however it becomes important when one needs to define some additional finite-sample properties.

We have to be careful that all these assumptions of OLS regression are satisfied while doing an econometrics test so that our efforts don't go wasted. These assumptions are extremely important as obtaining statistically valid results from the analysis depends on satisfying them. Having said that, many times these OLS assumptions will be violated. However, that should not stop us from conducting our econometric test. Rather, when the assumption is violated, applying the correct fixes and then running the linear regression model should be the way out for a reliable econometric test.

After this brief explanation of the OLS model and which assumptions have to be taken into account, the next step to follow is, as we have indicated at the end of the previous chapter 4, to check if our database fits with these assumptions aforementioned.

It should be said that for brevity, in the following sub-chapters only tests done with data referring to North zone of Italy are shown. The results of the other zones as well as those of Spain can be found in the annex.

5.1.2. Checking correlation between explanatory variables

First of all and to satisfy with assumption *iv*, one have to check if the explanatory variables have some kind of correlation between them as, if so, we would not have a good explanation of the model. There are two ways to check for potential correlations between sources, load and electricity and gas price.

- *Pearson Correlation Coefficient - (PCC)* [43]: is the most widely used correlation statistic to measure the degree of the relationship between linearly related variables. It measures the linear dependence among variables and determines the correlation intensity, relativity and direction. For the PCC, both variables should be normally distributed.
- *Spearman rank-order correlation coefficient - r_s* [44]: is a non-parametric test that is used to measure the degree of association between two variables. It does not carry any assumptions about the distribution of the data and is the appropriate correlation analysis when data are not normally distributed.

To check whether the variables are normally distributed or not, and hence whether to use the Pearson or Spearman test, it is used "*Jarque-Bera test" – JB* [45]. The test statistic JB test is defined as:

$$JB = n \cdot \left[\frac{\left(\sqrt{b_1}\right)^2}{6} + \frac{(b_2 - 3)^2}{24} \right] \qquad (5)$$

Where, n is the sample size, $\sqrt{b_1}$ is the sample skewness coefficient and b_2 is the kurtosis coefficient. Skewness (*b1*) is a measure of lack of symmetry in a distribution. A normal distribution is perfectly symmetrical and has zero skew. If b1 is more than zero, the distribution is skewed to the right, having more observations on the left. Kurtosis (*b2*) measures the thinness of tails of a probability distribution. Like skewness, kurtosis also shows how the distribution of a variable deviates from a normal distribution. If *b2* is larger than three indicates a higher peak and thin tails compared to a normal distribution. For more information to how calculate *b1* and *b2* see [45]. The test statistic is always nonnegative. The null hypothesis for the test is that the data is normally distributed; the alternative hypothesis is that the data does not come from a normal distribution.

- H0: the data is normally distributed;
- H1: the data does not come from a normal distribution.

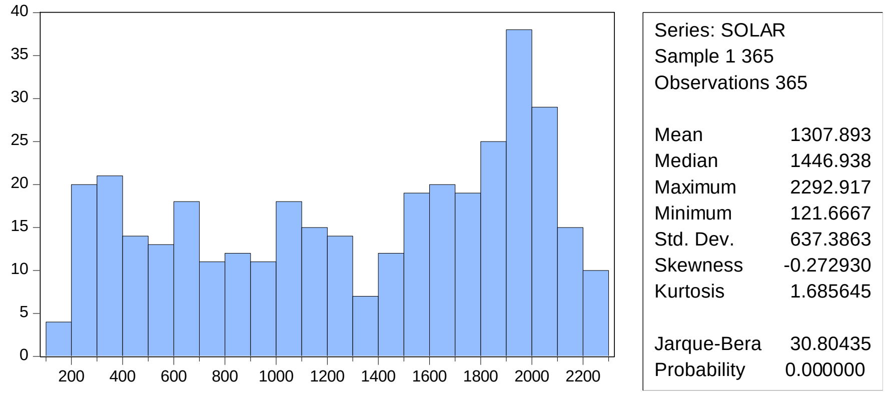

Figure 69: Results of the Jarque Bera on normal distribution of the SOLAR variable.

Figure 69 shows the obtained results for the data set of the variable "Solar". It has been used for this example daily data from solar generation for the North zone of Italy. A sufficiently small p-value from this test (normally less than 5%) means that the null hypothesis can be rejected and hence that the data does not come from a normal distribution. We run JB test for all variables and, as all p-value are < 5%, we reject the null hypothesis that the data is normally distributed and we check for correlation between the variables by using the Spearman test:

$$r_s = 1 - \frac{6 \cdot \sum d_i^2}{n(n^2 - 1)} \quad (6)$$

Where, n is the sample size and d_i is the difference between the ranks of corresponding variables. According to [44], the Spearman correlation coefficient r_s can take values from +1 to -1. A value of +1 indicate a perfect association of ranks, r_s of 0 indicates no association between ranks and a value of -1 indicates a perfect negative association of ranks. (See [44] for further information about Spearman test).

Table 7: Results of Spearman test: correlation matrix for North zone

		WIND	SOLAR	LOAD	PGAS
WIND	r_s	1.000000			
	p-value	-----			
SOLAR	r_s	-0.195144	1.000000		
	p-value	**0.0002**	-----		
LOAD	r_s	-0.049856	-0.058686	1.000000	
	p-value	**0.3422**	**0.2634**	-----	
PGAS	r_s	-0.195748	0.157306	0.152068	1.000000
	p-value	**0.0002**	**0.0027**	**0.0037**	-----

Table 7 is an example of the results of Spearman test: they are showed in a correlation matrix where it can be seen the r_s statistic between any pair of variables and the p-value for each r_s correlation value. Data used for the example have been daily data of renewable generation (wind and solar), load and gas price referring to North zone of Italy. The closer r_s is to zero, the weaker the association between the ranks. It can be seen that correlations between independent variables are weak (all values close to 0), therefore, according to [44], it can be affirmed that our model for North zone will not show collinearity issues in the regression.

As previously said, the results of these tests for the other zones of Italy as well as for Spain can be found on the annex. And all the results lead one to conclude that the model will not present collinearity issues in any area of study.

5.1.3. Unit roots test

The second step of our analysis consists in testing for unit roots in the series. Following Clò et al.[1] we use the Augmented Dickey-Fuller test (ADF) which tests according to [46]:

- The null hypothesis H0 that the series have a unit root, against
- Hypothesis H1 that the series are stationary

The existence of a unit root indicates that the time series is not stationary and it is random walk. The equation for the unit root test is the following:

$$y_t = \alpha + \rho y_{t-1} + \varepsilon_t \tag{7}$$

Where α is the constant of the regression and ε_t is the error term with mean value zero and constant variance. If ρ is equal to 1, the unit root exists and the series are random walk. In particular the null hypothesis is $\rho = 1$ against H1 $\rho < 1$. Once a value for the test statistic is computed it can be compared to the relevant critical value for the ADF test. The critical values included in the output are linearly interpolated from the table of values that appears in *Fuller (1996)* [47]. H0 of a unit root test is rejected if the test statistic is lower than the critical value. Table 8 shows an example of the ADF test. In this case t-Statistic is -2.85 and H0 can be rejected at 5% critical value.

Table 8: Example of Augmented Dickey-Fuller test

Null Hypothesis: SOLAR has a unit root
Exogenous: Constant
Lag Length: 4 (Automatic - based on AIC, maxlag=16)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.846682	0.0501
Test critical values:	1% level	-3.448312	
	5% level	-2.869351	
	10% level	-2.570999	

Since the analysed data is characterized by clustering volatility and structural breaks (unexpected changes in the time series) the outcome could be biased by using the ADF test. So, following the proven literature approach of Clò et al. [1], Woo et al. [48] and Ketterer et al. [49], we add in our analysis the Philips-Perron test (PP), which implements a unit root test that differs from the ADF test in the serial correlation and in the heteroscedasticity of the errors.

PP test includes an alternative and nonparametric method for testing a unit root, by estimating the non-augmented Dickey Fuller equation and changing the test statistic. In this way, its asymptotic distribution is unaffected by serial correlation. This test directly modifies the ADF test statistic [50]. Table 9 shows the results of the ADF and PP tests done with EViews for the exemplary case of one Italian market zone. The results for the other zones are reported in the annex.

Table 9: Augmented Dickey-Fuller test and Philips-Perron test results for variables at level. NORTH zone.

	At Level	PRICE	LOAD	SOLAR	WIND	PGAS
ADF test	t-Statistic	-2.1516	-3.5936	-2.8467	-3.1056	-3.2645
	p-value	**0.2248**	**0.0064**	**0.0529**	**0.0270**	**0.0174**
		n0	***	*	**	**
PP test	t-Statistic	-6.9078	-9.6788	-8.0080	-4.0038	-5.4072
	p-value	**0.0000**	**0.0000**	**0.0000**	**0.0016**	**0.0000**
		***	***	***	***	***

- *(*) significant at the 10% level; (**) significant at the 5% level, (***) significant at the 1% level and (no) not significant.*
- *Lag length based on Akaike Information Criterion (AIC)*
- *Probability based on MacKinnon (1996) one-sided p-values* [51]

With the ADF test the price series is not significant (p-value higher than 0.1). Other series (for example solar and wind) are not stationary at 1% critical value. For that reason, following the aforementioned methodology, we also consult the PP test. In this case results show that we can reject the null hypothesis of having a unit root for all variables and we can specify the multivariate regression model by using the variables in level. In other words, it is not necessary to carry out any kind of transformation on the data (i.e. "the first difference" that means creating a new variable by subtracting each value with its previous one).

5.1.4. Model

Our approach builds on a consolidated methodology adopted by Clò et al. [1] so, the analysis is done only with solar and wind generation and we omit from the model all other traditional and or programmable sources such as geothermal, hydro, gas and coal.

We model the spot price ("zonal market price" – ZMP for Italy) with a linear regression using as explanatory variables the daily average electricity load (LOAD), the power generation by renewable energy source, in particular, we will take into account power of photovoltaics (SOLAR) and eolic (WIND). This two would also be labeled in our analysis like as variable renewable energy source (RES) characterized by a variable production dependent on the availability of the main natural power source. Finally we include the price of gas (PGAS) because it improves the explanatory power of our model and it results significantly.

In the first version of the model, as done by Clò et al. [1], we include as explanatory variable only the daily total load (LOAD), while the dependent variable is the zonal price (ZMP). Additionally we introduce a vector of dummies (D) to control the seasonal effects, which includes: 30 dummies indicating the days of the month and 11 dummies indicating the month of the year. These dummies control for month and day effects than can affect electricity prices dynamics. The resulting equation for the Model 1 is the following.

$$ZMP = \beta_0 + \beta_1 LOAD + \gamma D + \varepsilon_t \tag{8}$$

As we are interested in understanding to what extent a change in the zonal price is driven by different factors of both together the load and renewable generation, in the second version of the model we add as explanatory variables the production from renewable sources (RES), which is the sum of wind and solar generation. The equation for the Model 2 is *(9)*:

$$ZMP = \beta_0 + \beta_1 LOAD + \beta_2 RES + \gamma D + \varepsilon_t \tag{9}$$

Model 3, with equation number *(10)*, split the RES effect between SOLAR and WIND generation:

$$ZMP = \beta_0 + \beta_1 LOAD + \beta_3 SOLAR + \beta_4 WIND + \gamma D + \varepsilon_t \tag{10}$$

Finally, equation *(11)* is used for Model 4. We add the daily spot price of natural gas as explanatory variable (PGAS).

$$ZMP = \beta_0 + \beta_1 LOAD + \beta_3 SOLAR + \beta_4 WIND + \beta_5 PGAS + \gamma D + \varepsilon_t \tag{11}$$

5.1.5. Test on the residuals

To check the correct specification of our model we run some tests on the residuals. First of all we test for serial correlation in the OLS residuals using the Durbin Watson statistic which tests [52]:

- the null hypothesis H0 that the errors are serially uncorrelated against;
- the alternative H1 that they follow a first order autoregressive process (AR(1)).

The test statistic is calculated with the following formula:

$$DW = \frac{\sum_{t=2}^{T}(e_t - e_{t-1})^2}{\sum_{t=1}^{T} e_t^2} \tag{12}$$

Where e_t are residuals from an OLS regression. The DW test reports a test statistic, with a value from 0 to 4, where if DW=2 there is no autocorrelation; if 0 < DW < 2 there is positive autocorrelation (common in time series data) and for 2 > DW > 4 there is negative autocorrelation (less common in time series data). A rule of thumb, according to [52], is that test statistic values in the range of 1.5 to 2.5 are relatively normal. Values outside of this range could be cause for concern. Also, values under 1 or more than 3 are a definite cause for concern. Durbin Watson test requires the use of tables [53] where it can be found the upper and lower critical values DW_U and DW_L for different value of *k* (the number of explanatory variables) and *n* (the length of our sample). If $DW<DW_L$, H0 is rejected; if $DW>DW_U$ one can't reject the null hypothesis and if $DW_L<DW<D_U$ the test is inconclusive.

The second test we apply on the residuals is Breusch-Pagan test for heteroscedasticity [47] that verifies the null hypothesis that the error variances are all equal. The Breusch-Pagan test is based on models of the type for the variances of the observations. The test statistic for the Breusch-Pagan test is nR^2, where *n* is the sample size and R^2 is the coefficient of determination of squared residuals from the regression. A small BP value along with an associated small p-value, indicates the null hypothesis is true. The alternative hypothesis is that the error variances are not equal, more specifically, as Y increases, the variances increase or decrease.

When applying the tests as described in the following chapter, it turns out that both heteroscedasticity and serial correlation are found in the residuals of the three regressions.

Therefore, again following Clò [1] we model the residuals assuming that they follow a first order autoregressive process AR(1), with $|\rho| < 1$ and ω_t being white noise.

$$\varepsilon_t = \rho\varepsilon_{t-1} + \omega_t \tag{13}$$

Table 10 is an example of the results obtained for serial correlation test on EViews: it can be seen that, before applying AR(1) assumption, p-value is less than 5% and the null hypothesis that there is no serial correlation has to be rejected. Once AR(1) is applied, p-value becomes much higher than 5% (around 0,9). In this case, H0 is accepted and one can confirm that after modelling the residuals, there is no serial correlation. Based on that, in the following chapter, the regressions are run using a generalized least-squares method to estimate the parameters in a linear regression model in which the errors are serially correlated and follow a first-order autoregressive process. The statistically significant estimates for ρ are in all cases of study around 0.1 and 0.9, indicating that the zonal price series have a first-order positive autocorrelation and affirm the validity of the AR(1) assumption.

Table 10: Serial correlation test on EViews. Before modelling the residuals (up) and after applying AR(1) assumption (down).

Serial correlation test BEFORE applying AR(1) assumption

Breusch-Godfrey **Serial Correlation LM Test**:			
F-statistic	5.292652	Prob. F(2,314)	0.0055
Obs*R-squared	11.80546	Prob. Chi-Square(2)	0.0027

Serial correlation test AFTER applying AR(1) assumption

Breusch-Godfrey **Serial Correlation LM Test**:			
F-statistic	0.008474	Prob. F(2,309)	0.9916
Obs*R-squared	0.019636	Prob. Chi-Square(2)	0.9902

Table 11 is an example of the entire table of results obtained applying the Model 1 for the exemplary case of the dataset from North zone in Italy. Using the same data, Table 10 are the results showed by EViews applying the Breusch test for the serial correlation before and after applying the AR(1) assumption.

Table 11: Example of the entire table of results for OLS methodology.

General information

Dependent Variable: ZONAL_PRICE_NORD
Method: Least Squares
Date: 02/15/20 Time: 15:15
Sample: 2 8762
Included observations: 8760

Independent variables: coefficient = β

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	22.54271	0.784911	28.72010	0.0000
LOAD_NORD	0.001752	2.62E-05	66.95306	0.0000
DUMMIES	[...]	[...]	[...]	[...]

Regression results and DW statistic

R-squared	0.704767	Mean dependent var	60.71300
Adjusted R-squared	0.702560	S.D. dependent var	15.41304
S.E. of regression	8.405982	Akaike info criterion	7.103270
Sum squared resid	614322.6	Schwarz criterion	7.156597
Log likelihood	-31046.32	Hannan-Quinn criter.	7.121440
F-statistic	319.2909	**Durbin-Watson stat**	0.257521
Prob(F-statistic)	0.000000		

Breusch-Pagan test

Heteroskedasticity Test: **Breusch-Pagan-Godfrey**			
F-statistic	12.04515	Prob. F(65,8694)	0.0000
Obs*R-squared	723.7055	Prob. Chi-Square(65)	0.0000
Scaled explained SS	4954.449	Prob. Chi-Square(65)	0.0000

To simplify and make it clearer to understand, in the following chapter it is presented only those values that are of immediate interest for our analysis. For more information, tables with all specifications can be found in the annex. Values presented have different levels of significance depending on the model used and the zone of analysis. This significance level (also called p-value) is reflected in the results with blue asterisks next to the value: three asterisks (***) means that p-value is less than 1%, two (**) that p-value is between 1% and 5%, and one asterisk (*) means that the significance of our value is between 5% and 10%. The chosen criterion is that a significance level up to 5% (three or two asterisks) is enough to consider that the result obtained is significant. On the contrary a p-value higher than 5% is considered not significant and as a consequence the variable is ignored.

6. RESULTS

In this chapter, the results of the OLS regression obtained of with the software Eviews are presented. It is composed by two sections, applying the before mentioned methodologic approach first on the data set from Italy (6.1) and subsequently on the data set from Spain (6.2).

6.1. Italy

Since the Italian energy market is not a single national zone, but, as mentioned before, split in six major commercial zones, first the results for the individual zones are presented.

6.1.1. North

Regressions results for North zone.Table 12 shows the results of the regressions for the methodology detailed in the previous chapter. In the column for Model 1 are reported the results for the regression number *(8)* with the dependent variable North zonal spot price and daily average electricity load (LOAD) as the only explanatory variable. The column for Model 2 reports the results for the equation number *(9)* where both RES and LOAD are used as explanatory variables. Solar and Wind coefficient results are reported separately in Model 3 with equation number *(10)*. Finally, the last column reports the results for the Model 4 that includes as explanatory variable the price of gas (PGAS). For brevity, table presented below, as well as all those presented from now on, do not report binary indicators (dummies).

Table 12: Regressions results for North zone.

Dependent variable: **NORTH ZONAL PRICE** *[€/MWh]*	Model 1	Model 2	Model 3	Model 4
LOAD: β_1	1.59*** (0.12)	1.58*** (0.11)	1.58*** (0.11)	1.18*** (0.08)
RES: β_2	-	-2.31** (0.86)	-	-
SOLAR: β_3	-	-	-2.34** (0.87)	-2.91*** (0.61)
WIND: β_4	-	-	-42.29(no) (100.5)	(no)
PGAS: β_5	-	-	-	1.50*** (0.08)
CONSTANT: β_0	23.13*** (3.51)	26.28*** (3.64)	26.63*** (3.74)	(no)
R^2	0.8258	0.8307	0.8308	0.931
R^2_adj	0.8018	0.8068	0.8064	0.931
ρ	0.584	0.575	0.574	0.894
DW_0	0.858	0.889	0.895	1.597
DW	2.208	2.191	2.194	1.981

- **p-value < 10% critical value, **p-value < 5% critical value, ***p-value < 1% critical value, (no) not significant*
- *Standard errors are reported in parenthesis.*
- *DW_0 indicates the results of the Durbin Watson statistic before correcting for serial correlation in the residuals. DW indicates the results after applying AR(1) assumption.*

The values on Table 12 refer to price variation [€/MWh] for every GW of energy generation mix (RES, SOLAR and WIND) but for the gas price, values are referred to zonal price variation for every €/MWh increased of gas price. This means that for example, regarding the values reported in the last column, a marginal increase of 1 GW in the production from Solar source **reduces** the daily north electricity price by 2.91 €/MWh. On the contrary, a marginal increase of 1 €/MWh of the price of gas **increases** the daily north electricity price by 1.50 €/MWh.

It is remarkable that the value for Load diminished from model 1 to 5. This may be due to as in the latter we add the price of gas as another explanatory variable, it can cause a variation in the coefficients of the other variables in order to better explain the regression. It is important also to refer to WIND component. As it can be seen in Table 12, the cell highlighted in red shows that the value for coefficient β_4 are not significant. The fact that wind generation is not significant in North zone is confirmed with Model 4, since Solar results obtained in the last model are almost the same as those obtained for RES in Model 2 (where solar and wind are taken into account together).

It can be seen that DW statistic before applying serial correlation on the residuals (DW_0) is 0<DW<2, which means that there is a positive autocorrelation in the residuals. After modelling the residuals, Durbin Watson statistic for all four models (DW) is around 2, the value for which the model has no correlation problems. Concerning R^2 coefficient, its value is around 0.8-0.9, which suggests a good fit to the data.

6.1.2. Central-North

In that case, Table 13 reports, for Central-North zone, the value of the regression coefficients (β_i) obtained for each independent variable by applying all four models aforementioned.

Table 13: Regression results for Central-North zone

Dependent variable: **CENTRAL-NORTH ZONAL PRICE** *[€/MWh]*	Model 1	Model 2	Model 3	Model 4
LOAD: β_1	8.77*** (0.78)	8.66*** (0.7)	8.76*** (0.75)	6.65*** (0.5)
RES: β_2	-	-5.27** (2.2)	-	-
SOLAR: β_3	-	-	-5.74** (0.7)	-7.68*** (1.98)
WIND: β_4	-	-	-40.52** (20.5)	-64.74*** (14.87)
PGAS: β_5	-	-	-	1.74*** (0.19)
CONSTANT: β_0	19.83*** (3.35)	22.53*** (3.4)	23.41*** (3.44)	-8.66*** (4.77)
R^2	0.8206	0.8236	0.8256	0.8966
R^2_adj	0.7959	0.7987	0.8003	0.8812
ρ	0.5832	0.5892	0.5949	0.1706
DW_0	0.8697	0.8591	0.8523	1.657
DW	2.1823	2.1610	2.1716	1.955

- **p-value < 10% critical value, **p-value < 5% critical value, ***p-value < 1% critical value, (no) not significant*
- *Standard errors are reported in parenthesis.*
- *DW_0 indicates the results of the Durbin Watson statistic before correcting for serial correlation in the residuals. DW indicates the results after applying AR(1) assumption.*

In this case it is important to highlight Model 3. The analysis done before serial correlation gave not significant values for Solar and Wind but, as we have explained in chapter 0, heteroscedasticity can lead to incorrect estimations. It has been checked once AR(1) residual assumption has been applied: p-values for both coefficients are less than 5% confidence level and one conclude that β_3 and β_4 are significant in Center-North zone. This fact is also checked when applying Model 4, where all coefficients became significant at 1% critical value. Another value to highlight is the high impact of WIND to electricity price, with a reduction of 64.74 €/MWh per each GW of generation.

DW coefficients before correcting for serial correlation in the residuals (DW_0) reflect that there is a positive autocorrelation: 0 < DW < 2 (see chapter 0). And, in the same way that happens in the North zone, Breusch-Pagan test confirms also that standard errors are non-constant and present heteroscedasticity. After modelling the residuals, Durbin Watson statistic for all four models (DW) is around 2, a value for which the model has no correlation problems. Concerning regression's R^2 coefficient, it suggests a good fit to the data because its value is around 0.8.

6.1.3. Central-South

Table 14 reports, for Central-South zone, the value of the regression coefficients (β_i) obtained for each explanatory variable by applying all four models aforementioned.

Table 14: Regression results for Central-South zone

Dependent variable: **CENTRAL SOUTH ZONAL PRICE** *[€/MWh]*	Model 1	Model 2	Model 3	Model 4
LOAD: β_1	7.47*** (0.7)	7.45*** (0.7)	7.52*** (0.7)	4.90*** (0.5)
RES: β_2	-	-6.19*** (1.1)	-	-
SOLAR: β_3	-	-	-3.95** (1.8)	-4.89*** (1.4)
WIND: β_4	-	-	-7.57*** (1.2)	-8.52*** (1.03)
PGAS: β_5	-	-	-	1.50*** (0.16)
CONSTANT: β_0	15.47*** (3.93)	21.86*** (3.73)	20.59*** (3.88)	(no)
R^2	0.7836	0.8064	0.8087	0.8710
R^2_adj	0.7539	0.7791	0.7811	0.8522
ρ	0.6061	0.6005	0.6002	0.187
DW_0	0.8347	0.8512	0.8511	1.6511
DW	2.134	2.164	2.19	2.0034

- *p-value < 10% critical value, **p-value < 5% critical value, ***p-value < 1% critical value, (no) not significant*
- *Standard errors are reported in parenthesis.*
- *DW_0 indicates the results of the Durbin Watson statistic before correcting for serial correlation in the residuals. DW indicates the results after applying AR(1) assumption.*

In this situation, in the same way that happens with the previous case, all coefficients are significant at 1% level. In the next chapter values obtained will be discussed. Only remark that the value for Load decreases from model 1 to 4 and values for Solar and Wind present a slight increase. As in the same way as for the other zones, this may be due to that in the latter we add the price of gas as another explanatory variable and it can cause a variation in the coefficients of the other variables in order to better explain the regression.
Durbin Watson statistic before applying the AR(1) assumption (DW_0) shows that there is serial correlation on the residuals, with values 0 <DW<2. After applying for serial correlation, values became around 2, a value for which the model has no correlation problems. R^2 are around 0,8 that suggests a good fit to the data. Finally, a value of ρ of 0.6 and 0.2 confirms the AR(1) hypothesis: $|\rho|<1$.

6.1.4. South

Table 15 shows the results obtained for each model (from 1 to 4), when applying the methodology for South zone.

Table 15: Regression result for South zone

Dependent variable: **SOUTH ZONAL PRICE** *[€/MWh]*	Model 1	Model 2	Model 3	Model 4
LOAD: β_1	10.17*** (1.6)	11.16*** (1.5)	11.38*** (1.5)	8.06*** (1.2)
RES: β_2	-	-4.89*** (0.6)	-	-
SOLAR: β_3	-	-	-1.91$^{(no)}$ (0.41)	(no)
WIND: β_4	-	-	-5.13*** (0.6)	-5.32*** (0.5)
PGAS: β_5	-	-	-	1.43*** (0.16)
CONSTANT: β_0	22.42*** (4.77)	28.14*** (4.33)	25.27*** (4.61)	(no)
R^2	0.7148	0.7804	0.7847	0.8477
R^2_adj	0.6755	0.7494	0.7536	0.8262
ρ	0.5908	0.5668	0.5782	0.2042
DW_0	0.8735	0.9194	0.9044	1.6127
DW	2.045	2.1623	2.1834	1.9952

- **p-value < 10% critical value, **p-value < 5% critical value, ***p-value < 1% critical value, (no) not significant*
- *Standard errors are reported in parenthesis.*
- *DW_0 indicates the results of the Durbin Watson statistic before correcting for serial correlation in the residuals. DW indicates the results after applying AR(1) assumption.*

We highlight in this case the value obtained for β_3 in model 3. In the same way that has happened before with WIND variable in the North, the model has reported before applying AR(1) assumption an erroneous value of the result for Solar coefficient. This has occurred due to heteroscedasticity which can lead to incorrect estimations. After correcting serial correlation, the no significance of solar in the South zone is checked when applying Model 4 since value for WIND is closer to RES value for Model 2.

Again it is seen that all DW_0 values reflect that there is a positive autocorrelation on the residuals and after applying the AR(1) assumption the model has no correlation problems with DW values around 2. The Breusch-Pagan test confirms also that standard errors are non-constant and present heteroscedasticity. R^2 suggests a good fit to the data with values between 0,7 and 0,8.

6.1.5. Sicily

Table 16 reports, for Sicily, the value of the regression coefficients (β_i) obtained for each explanatory variable by applying all four models aforementioned.

Table 16: Regression results for Sicily zone

Dependent variable: **SICILY ZONAL PRICE** *[€/MWh]*	Model 1	Model 2	Model 3	Model 4
LOAD: β_1	30.10*** (2.45)	37.36*** (2.2)	35.41*** (2.3)	25.11*** (3.3)
RES: β_2	-	-22.21*** (1.8)	-	-
SOLAR: β_3	-	-	-5.97(no) (6.2)	(no)
WIND: β_4	-	-	-22.70*** (1.8)	-22.47*** (2.2)
PGAS: β_5	-	-	-	0.90*** (0.23)
CONSTANT: β_0	(no)	(no)	(no)	(no)
R^2	0.7189	0.8027	0.8086	0.8189
R^2_adj	0.6812	0.7755	0.7816	0.7934
ρ	0.6038	0.5897	0.6031	0.5755
DW_0	0.8706	0.8752	0.8533	0.9007
DW	1.9069	2.0113	2.0128	2.0128

- **p-value < 10% critical value, **p-value < 5% critical value, ***p-value < 1% critical value, (no) not significant*
- *Standard errors are reported in parenthesis.*
- *DW_0 indicates the results of the Durbin Watson statistic before correcting for serial correlation in the residuals. DW indicates the results after applying AR(1) assumption.*

We highlight in this case the value obtained for β_4 (WIND). A decrease of 22.47 €/MWh of the zonal price is a high impact of the wind source compared to the no-significant impact of solar. The impact of 25.11 €/MWh of load is also remarkable. It can be seen that Sicily is an interesting case to comment on the next chapter. Durbin Watson values around 2 indicate that the model does not present correlation problems after applying AR(1) assumption and R^2 suggests a good fit to the data.

6.1.6. Sardinia

In this case, Table 17 reports, for Sardinia, the value of the regression coefficients (βi) obtained for each explanatory variable by applying all four models aforementioned.

Table 17: Regression results for Sardinia zone.

Dependent variable: **SARDINIA ZONAL PRICE** *[€/MWh]*	Model 1	Model 2	Model 3	Model 4
LOAD: β_1	28.34*** (4.7)	25.49*** (5.2)	26.02*** (5.2)	19.34*** (5.0)
RES: β_2	-	-4.79** (2.4)	-	-
SOLAR: β_3	-	-	10.44(no) (2.61)	(no)
WIND: β_4	-	-	-5.16** (2.5)	-7.70*** (1.9)
PGAS: β_5	-	-	-	1.76*** (0.2)
CONSTANT: β_0	22.53*** (4.91)	26.92*** (5.74)	23.95*** (5.79)	(no)
R^2	0.7234	0.7268	0.7287	0.8249
R^2_adj	0.6854	0.6883	0.6895	0.7996
ρ	0.5327	0.5308	0.5383	0.1455
DW_0	0.9926	0.9891	0.9851	1.7122
DW	2.1119	2.1383	2.1405	1.9989

- **p-value < 10% critical value, **p-value < 5% critical value, ***p-value < 1% critical value, (no) not significant*
- *Standard errors are reported in parenthesis.*
- *DW_0 indicates the results of the Durbin Watson statistic before correcting for serial correlation in the residuals. DW indicates the results after applying AR(1) assumption.*

Sardinia is a case analogous to Sicily. Model 3 reports that Solar is no-significant and it is checked when applying Model 4. In this zone and Wind causes a reduction of the zonal price of 7.70 €/MWh and the high impact of load compared to the other zones, with a value of 19.34 €/MWh is also remarkable. Also in this case DW presents values around 2 which indicate that all four models do not present serial correlation problems.

6.2. Spain

2018 has been a wet year placing hydro power production 85% higher than 2017. At the same time it ranked second behind wind power with 34% of total renewable energy generated in Spain. On the other hand solar generation still has a comparatively small share compared to Italy. Hydroelectric power generation has traditionally been the main renewable source in Spain, only until 2009 when it was surpassed by wind power in terms of energy produced. For all these reasons just mentioned, it has been considered convenient that, apart from analysing solar and wind, hydroelectric reservoir is also analysed. Therefore we add to our analysis an extra model. The equation for Model 5 become as follows:

$$SMP = \beta_0 + \beta_1 LOAD + \beta_3 SOLAR + \beta_4 WIND + \beta_5 PGAS + \beta_6 HYDRO + \gamma D + \varepsilon_t \qquad (15)$$

Results obtained for Spain are shown in Table 18:

Table 18: Regression results for Spain.

Dependent variable: **SPANISH MARKET PRICE** *[€/MWh]*	Model 1	Model 2	Model 3	Model 4	Model 5
LOAD: β_1	0.056*** (0.003)	0.057*** (0.004)	0.056*** (0.004)	0.051*** (0.004)	0.045*** (0.004)
RES: β_2	-	-1.53** (0.1)	-	-	-
SOLAR: β_3	-	-	-0.39(no) (0.8)	-0.21(no)	(no)
WIND: β_4	-	-	-1.54*** (0.1)	-1.50*** (0.1)	-1.45*** (0.1)
PGAS: β_5	-	-	-	0.666*** (0.21)	0.926*** (0.15)
HYDRO: β_6	-	-	-	-	-1.72*** (0.5)
CONSTANT: β_0	(no)	13.19*** (3.38)	12.11*** (3.50)	(no)	(no)
R^2	0.8376	0.9076	0.9086		0.9157
R^2_adj	0.8158	0.8945	0.8954		0.9035
ρ	0.5874	0.5696	0.5902		0.4793
DW_0	0.8724	0.9451	0.9443		1.092
DW	1.949	2.050	2.081		2.003

- **p-value < 10% critical value, **p-value < 5% critical value, ***p-value < 1% critical value, (no) not significant*
- *Standard errors are reported in parenthesis.*
- *DW_0 indicates the results of the Durbin Watson statistic before correcting for serial correlation in the residuals. DW indicates the results after applying AR(1) assumption.*

On first sight, the most relevant thing to comment with these results is the coefficient β_3 for solar generation. Model 3 shows that, after applying residual assumption, this explanatory variable is not significant in the regression as the confidence level of its p-value is larger than 10%. The second point important to highlight are the results for β_6. By adding hydroelectric generation in the analysis it can be seen that its significance is less than 1%. The impact on final price is almost the same as that of wind generation (-1.72 €/MWh and -1.45 €/MWh respectively). Regarding the impact of the price of the gas, increasing this variable by one unit (1 €/MWh) causes an increase in the Spanish market price of 0.926 €/MWh.

Durbin Watson statistic (DW_0) shows that there is serial correlation on the residuals but it rises to a value around 2 after applying the AR(1) assumption. As it is said in the previous analysis with a value of DW=2 the model do not present correlation problems. The value for R^2 are around 0.9 and suggests a good fit to the data.

7. DISCUSSION

After having obtained individual results for single zones and countries, in this section we are confronting and discussing the respective results to compare how differently the various sources impact prices in different markets. First, it is presented the comparison between the six commercial zones from Italy followed by the comparison between Italy and Spain.

7.1. Comparison between Italian commercial zones

This section presents the comparison of results obtained for all six Italian commercial zones. Results for Model 4 are reported in Table 19, regression model in which all explanatory variables are taken into account.

Table 19: Comparison of results between zones.

	Zonal market price *[€/MWh]*					
Variable coefficient	**NORTH**	**CENTRAL NORTH**	**CENTRAL SOUTH**	**SOUTH**	**SICILY**	**SARDINIA**
LOAD: β_1	1.19***	6.64***	5.11***	8.06***	25.11***	19.34***
SOLAR: β_3	-2.89***	-7.68***	-4.46***	(-)	(-)	(-)
WIND: β_4	(-)	-64.74***	-8.36***	-5.31***	-22.47***	-7.71***
PGAS: β_5	1.48***	1.74***	1.56***	1.44***	0.91***	1.76***
ρ	0.2112	0.1587	0.1785	0.2042	0.5755	0.1455

**p < 10%, **p < 5%, ***p < 1%, (-) no significative*

The statistically significant estimates for β_1 support that rising zonal loads tend in general to raise zonal market prices based on the data from 2018. The intensity of this effect is pronounced with varying intensity. The lowest effect is in the North zone, with a value of 1.19 €/MWh for each 1000 MWh increase; followed by Central South, Central North and South with values of 5.11 €/MWh, 6.64 €/MWh and 8.06 €/MWh respectively. The highest effect is in the islands reaching a value of 25.11 €/MWh in Sicily. Having less influence in the Northern zones could be due to that North is the part of the territory most connected with the other European markets. In such case, the increase of load of an individual zone has little effect on zonal price as it can be balanced with the imports and exports of energy with other countries. In the same way, the high impact on the islands may be caused by the limitation of trade with other territories.

The statistically significant estimates for β_3 indicate that solar generation is not significant in South zones (including the islands). However, a 1000 MWh increase in solar generation reduces market price by 2.89 €/MWh in the North followed by a reduction of 4.46 €/MWh in Central South. The highest effect is found in Central North with a reduction of 7.68 €/MWh on market price.

Estimates for β_4 indicate that wind generation is not significant in the North. However, it has the highest impact in Central North with a reduction of 64.74 €/MWh. Also solar has the highest impact. This fact could be attributed to the small size and delicate location of the zone in the middle of Italy. Load, on the other hand, has not the highest impact in this zone, although it remains significant.

The price of gas β_5 affects the zonal price in a much higher way that the renewable generation mix and total load. It can be seen the big influence of a variation in the gas price but the effect remains relatively constant for all zones. Increasing this price by one unit causes an increase in the zonal market price from 0.91 €/MWh in Sicily to 1.76 €/MWh in Sardinia.

It should be noted that results show that in general, RES have a detrimental effect on the price in all zones. Affecting both sources, solar and wind together in the center of the territory. Decomposing RES, it is interesting to stress how the impacts of wind and solar vary across different Italian zones. While both prove to have in general a decreasing impact on the electricity spot price, wind is the main driver of the electricity price reduction in the southern zonal areas whereas solar has a more significant decreasing impact on the northern zone prices

Everything explained above can be reflected also on Figure 70. This bar plot reports the results of Table 19 for each zone separated by sources.

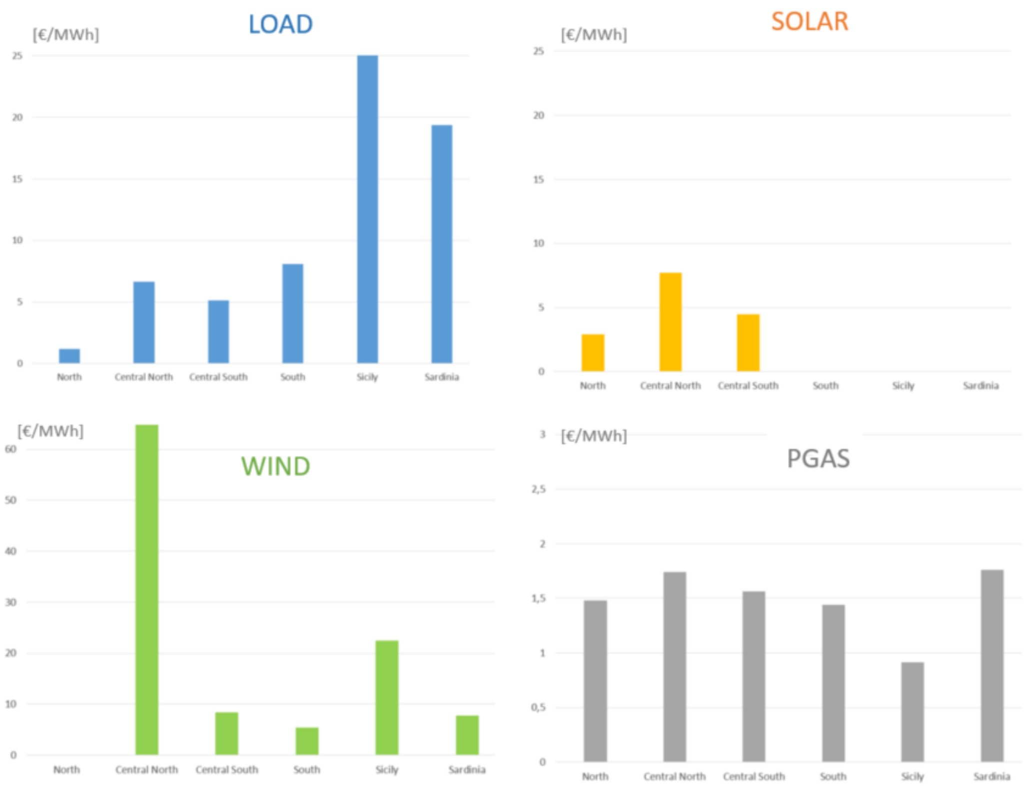

Figure 70: Comparison of results between Italian zones

7.2. Comparison between Italy and Spain

The solar and wind coefficients previously estimated indicate the impact of an additional GWh produced by these sources on the daily average market price. Table 20 shows, for Model 4, the summary of results for each market zone from Italy and for the single market in Spain.

Table 20: Comparison of results between Italy and Spain.

	Market price *[€/MWh]*						
	ITALY						SPAIN
Variable coefficient	NORTH	CENTRAL NORTH	CENTRAL SOUTH	SOUTH	SICILY	SARDINIA	
LOAD: β_1	1.19***	6.64***	5.11***	8.06***	25.11***	19.34***	0.045***
SOLAR: β_3	-2.89***	-7.68***	-4.46***	(-)	(-)	(-)	(-)
WIND: β_4	(-)	-64.74***	-8.36***	-5.31***	-22.47***	-7.71***	-1.45***
GAS_PRICE: β_5	1.48***	1.74***	1.56***	1.44***	0.91***	1.76***	0.944***
HYDRO: β_6	-	-	-	-	-	-	-1.72***
ρ	0.894	0.1706	0.1931	0.2042	0.5755	0.1455	0.4415

**p* < 10%, ***p* < 5%, ****p* < 1%, (-) no significative*

Starting with Italy, we have to highlight the characteristics of the six Italian zones that influence the competitiveness level. Big zones with many players plus a comparatively larger generation and demand in general, such as North, Central North, Central South show a higher level of competitiveness (reflected on lower prices) with respect to Sardinia and Sicily, that can be considered as smaller markets, with few players that can also act strategically on the MGP and on ex-ante MSD. We also have to take into account that a raise of 1 GW does not impact so much in the percentage in big zones as + 1 GW in smaller zones.

One of the most important points reflected on these results is the importance of the interconnections. Differences in zonal prices are determined by limitations in transmission capacity. Smaller zones with less players would normally have no impact on the zonal price if the transmission capacity would be unlimited. So, ideally all zones would be one zone. But since this is not the case and capacities are limited, the difference between big and smaller zones become important. It can be assumed that zonal prices give a measure of the local congestion of the grid. Difficulties in managing grid connections with the islands could be another reason that explain the higher prices registered in Sicily and Sardinia. Italian electricity market is an interesting study case. As it can be seen from the analysis, there are some zones that are competitive and have a high level of interconnections that brings efficiency, and there are other zones that are small and not so competitive, also because of the lack of interconnections.

Following with Spain, highlight the point that, compared to Italy, there is few solar generation and because of that, there might be other factors that have a stronger impact on the price than solar. An additional reason could be the different mix structure for Spain, as explained in chapter 3, with Nuclear in the first place unlike Italy which is gas. Even so, it is clearly seen that both wind and hydro generation have a very similar impact on the energy market price. Another point to highlight is the low impact of load. A value of only 0.045 €/MWh means that there is no impact in prices and this fact may be due to a better interconnection with other countries or within the country. The excess or lack of demand can be balanced in a very optimal way from energy's exports and imports with other countries and thus the Spanish energy price being relatively unchanged. Finally also say that gas prices and spot energy prices are closely related since the former affects in a very plausible way on the latter, both in Italy and in Spain.

The comparison between Italy and Spain can also be reflected on Figure 71. This bar plot reports the results of Table 20 for each Italian zone and for Spain, separated by sources.

Figure 71: Comparison results between Italy and Spain.

8. Complementary analysis

8.1. Italian analysis with hourly data

On the previously detailed analysis we followed Clò et al. [1] because it is a well-proven approach. However we believe that there is additional value in doing the analysis using hourly data, which we are losing by analysing only daily averaged data. Due to the impossibility of obtaining hourly data for the variable "price of gas" we had limited the analysis by using daily data. We believe that the price of gas is very important to be in our regression analysis because it has a very relevant and plausible impact on the spot price of the energy market. Therefore, not taking gas price into account could lead us to not optimal conclusions about our analysis. In this chapter it is presented a secondary analysis done for Italy using hourly data. The methodology used is exactly the same as that used previously for daily data. The points in which this analysis differs are the addition of 23 dummies for each hour of the day to our vector *D*. In this way we can control seasonal effects for hour. The regression model is:

$$ZMP = \beta_0 + \beta_1 LOAD + \beta_3 SOLAR + \beta_4 WIND + \gamma D + \varepsilon_t \tag{16}$$

By having data for each hour means that our analysis will have more observations compared to the analysis done with daily data. The sample goes from having 365 data in a whole year (one value per day) to a length of 8760, one value each hour of the day for the whole year. Below it is presented only the detailed results obtained for one significant zone, in this case it is chosen Central South. At the end, general results for each zone is presented so that it will be easier to see differences between Italian market zones.

Table 21: Regression results for hourly data. Central South zone.

Dependent variable: **CENTRAL- SOUTH ZONAL PRICE** *[€/MWh]*	Model 1	Model 2	Model 3
LOAD: β_1	9.88*** (0.2)	10.85*** (0.2)	11.12*** (0.21)
RES: β_2	-	-7.28*** (0.37)	-
SOLAR: β_3	-	-	-9.06*** (0.47)
WIND: β_4	-	-	-4.12*** (0.63)
CONSTANT: β_0	14.15 (1.64)	13.43 (1.53)	11.426 (1.55)
R^2	0.9071	0.9108	0.9112
R^2_adj	0.9064	0.9101	0.9104
ρ	0.871	0.8583	0.8623
DW_0	0.267	0.307	0.308
DW	1.861	1.908	1.919

- **p-value < 10% critical value, **p-value < 5% critical value, ***p-value < 1% critical value, (no) not significant*
- *Standard errors are reported in parenthesis.*
- *DW_0 indicates the results of the Durbin Watson statistic before correcting for serial correlation in the residuals. DW indicates the results after applying AR(1) assumption.*

In Model 3, after splitting RES, both variables solar and wind have been significant at 1% level with an impact of reduction of electricity price of 9.06 €/MWh and 4.12 €/MWh respectively. In the same way as with the previous analysis for daily averaged data, Table 22 shows the results of the regressions of models 1, 2 and 3. DW statistics before correcting serial correlation (DW_0) are 0 <DW< 2 and show that there is positive autocorrelation in the residuals. Is it true for heteroscedasticity test: p-value for Breusch-Pagan test is lower than 5%, the null hypothesis that the error variances are all equal is rejected. After modelling the residuals, Durbin Watson statistic for all three models (DW) is around 1.9, a value much more closely to 2 in which the model has no correlation problems. R^2 coefficient suggests a good fit to the data because its value is 0.9. The statistically significant estimates for ρ are around 0.85, indicating that in the same way as for daily data, the zonal price series have high first-order positive autocorrelation and affirm the validity of the AR(1) assumption.

8.1.1. Comparison between zones

This section presents the comparison of results obtained for all six Italian commercial zones using hourly data. Results for Model 3 are reported because is through this model where all explanatory variables are taken into account.

Table 22: Comparison between Italian zones using hourly data.

	Zonal market price *[€/MWh]*					
Variable coefficient	**NORTH**	**CENTRAL NORTH**	**CENTRAL SOUTH**	**SOUTH**	**SICILY**	**SARDINIA**
LOAD: β_1	2.72***	13.1***	11.12***	10.82***	35.7***	32.73***
SOLAR: β_3	-1.72***	-10.8***	-9.06***	-6.02***	-33.36***	-29.78***
WIND: β_4	(-)	(-)	-4.12***	-2.10***	-15.42***	-3.54**
ρ	0.8940***	0.8648***	0.8623***	0.8717***	0.8188***	0.8967***

**p < 10%, **p < 5%, ***p < 1%, (-) no significative*

The big difference that can be find in Table 22 compared to the previous case, where daily data has been used, is the fact that the estimate values for β_3 indicate that solar is significant in all zones of Italy. We obtain energy from solar panels only a few hours a day, therefore it turns out that the impact seems to be stronger on an hourly basis. However, wind has rather a daily impact, being wind generation more constant from day to day also not having such a plausible difference between hours as solar.

In the same way as in the previous analysis, Table 22 also shows the importance of interconnections: the increase of load of an individual zone has little effect on the North as it can be balanced with the imports and exports of energy with other countries, but has a high impact on the islands may be caused by the limitation of trade with other territories.

9. CONCLUSIONS

This work contributes to a very relevant line of research in the assessment of the impact of an increase in renewable energy in electricity markets, particularly on the electricity prices. It is especially interesting to perform this study in Italy where the commercial market is divided in different zones so on a case by case analysis, the outcomes are more detailed and can discover distinctive traits of a single zone in a single market or they can find either similarities between distant regions or differences between close zones.

This analysis differs from other studies in that Italian data are taken separately between commercial zones and results are compared with another European market: the Spanish electricity market. It is also one secondary analysis done for Italy. The difference with the main one is based on the regularity of data collection in order to see different price impact behaviors depending on the data used. While the former uses daily data the later uses data for each hour.

To detect the impact on electricity prices, it is followed a consolidated methodology adopted by Clò et al. [1] and developed an empirical analysis for Italy's commercial markets and for the whole Spanish market by using a multivariate regression. It is considered daily averaged data (calculated from hourly data) for the renewable generation mix (specifically solar and wind) and spot electricity price from the respective day-ahead markets for the whole year 2018.

The results obtained support the hypothesis that rising zonal loads tend in general to raise zonal market prices based on the data from 2018. The intensity of this effect is pronounced with varying intensity. In Italy the lowest effect is in the North zone, with a value of 1.19€/MWh for each 1000 MWh increase; followed by Central South, Central North and South with values of 5.11 €/MWh, 6.64 €/MWh and 8.06 €/MWh respectively. The highest effect is in the islands reaching a value of 25.11 €/MWh in Sicily. Having less influence in the Northern zones could be due to that North is the part of the territory most connected with the other European markets. In such case, the increase of load of an individual zone has little effect on zonal price as it can be balanced with the imports and exports of energy with other countries. In the same way, the high impact on the islands may be caused by the limitation of trade with other territories. The low impact of load in Spain, with a value of only 0.045 €/MWh, could mean that it has a better interconnection with other countries or within the country than Italy. The excess or lack of demand can be balanced in a very optimal way from energy's exports and imports with other countries and thus the Spanish energy price being relatively unchanged.

Decomposing RES, it is interesting to stress how the impacts of photovoltaics and wind vary across different Italian zones. While both prove to have in general a decreasing impact on the electricity spot price, wind is the main driver of the electricity price reduction in the southern zonal areas whereas solar has a more significant decreasing impact on the northern zone price. Eventually, Central North is the zone with the highest impact of both renewable sources. This fact could be attributed to the small size and delicate location of the zone in the middle of Italy. Southern zones, for example, have the highest share of wind generation in Italy and on a windy day they produce much more energy than needed. This excess of energy is sold to the North zones. In Spain, no evidence is found for photovoltaics for electricity price reduction. On the other hand, an increase of 1 GWh of wind and hydro decreases the Spanish electricity price by 1.76 €/MWh and 1.72 €/MWh respectively. Compared to Italy, there is few solar generation and because of that, there might be other factors that have a stronger impact on the price than solar. An additional reason could be the different mix structure for Spain, as explained in chapter 3, with Nuclear in the first place unlike Italy which is gas. Even so, it is clearly seen that both wind and hydro generation have a very similar impact on the energy market price.

A finally remark is the high correlation between the price of gas and electricity. The results obtained for both Italy and Spain reflect the assumption: an increase of 1 €/MWh of gas price causes statistically an electricity price increase between 0,90 and 1,73 €/MWh in Italy (depending on the zone) as well as an increase of 1.76 €/MWh in Spain.

The big difference found in the results obtained in the Italian analysis using hourly data, compared to the daily data case, is that solar comes out significant in all zones of Italy. We obtain energy from solar panels only a few hours a day, therefore it turns out that the impact seems to be stronger on an hourly basis. However, wind has rather a daily impact, being wind generation more constant from day to day also not having such a plausible difference between hours as solar.

Given the EU policies, renewable capacity will continue to increase in Europe. Given the recently adopted renewable energy target, 2030 “Framework for climate and energy”, based on the 2020 framework, renewable goals are set at a threshold of at least 27% share of energy consumption. The price impacts this work presents depend on the total load of production, energy generation and their variations. Hence, one might assume that the impacts become stronger unless the generation mix or market design changes. Therefore future research is necessary to investigate if lower electricity prices encourage new investments in electricity generation, and if renewable electricity regulation should be developed and adapted further towards a more market oriented structure that remunerates renewable electricity during phases of high electricity price.

Further extension of this work can entail the use of hourly data for generation mix and prices. The impossibility to get this kind of data for the gas price has induced to run the analysis using daily average (as done by Clò et al. [1]) in order to take also into account gas price variable. Even so, a secondary analysis using hourly data has been done (limited to the data and with a respectively limited model) and results have been presented for each market zone of Italy.

This work quantified now the impact of such intermittent and non-programmable generation on the electricity spot price. Since it is apparent however that such type of varying generation requires also a greater quantity of balancing and ancillary services, it would be interesting to quantify in a subsequent step the price impact on the named market of ancillary services. The constant balancing between loads and generation has indeed become a critical issue in recent years and it is set to worsen due to the increasing penetration of renewable energy sources. They are still disincentivised to supply dispatchment services because of their intermittent and not-predictable production.

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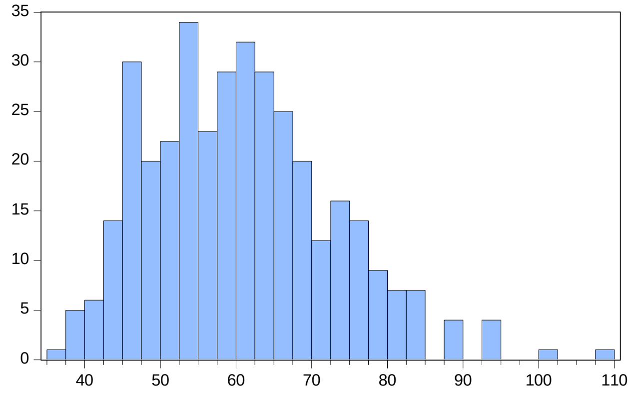
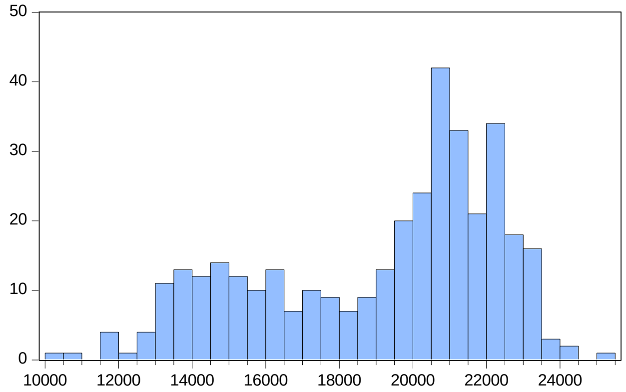
ANNEX

JARQUE BERA TEST

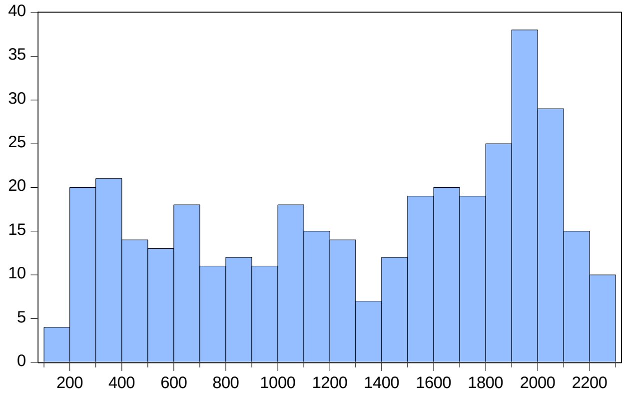
NORTH



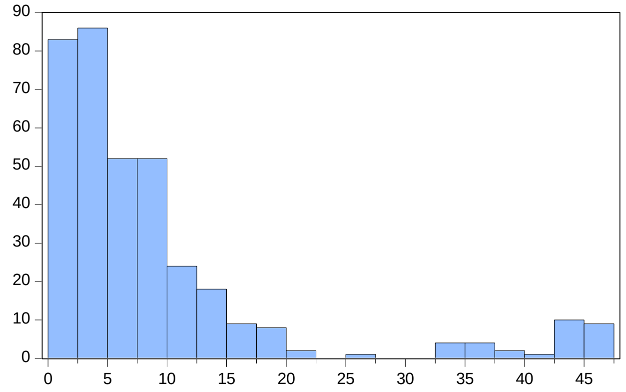
Series: PRICE	
Sample 1 365	
Observations 365	
Mean	60.71154
Median	59.88562
Maximum	107.7766
Minimum	37.42250
Std. Dev.	12.04913
Skewness	0.609680
Kurtosis	3.344752
Jarque-Bera	24.41992
Probability	0.000005



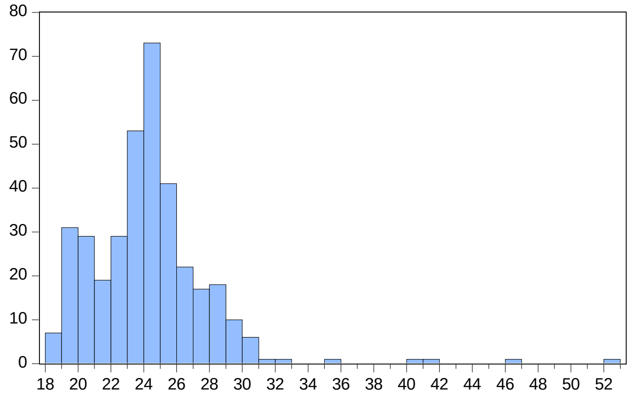
Series: LOAD	
Sample 1 365	
Observations 365	
Mean	19114.97
Median	20281.71
Maximum	25268.71
Minimum	10476.88
Std. Dev.	3246.119
Skewness	-0.621277
Kurtosis	2.222402
Jarque-Bera	32.67664
Probability	0.000000



Series: SOLAR	
Sample 1 365	
Observations 365	
Mean	1307.893
Median	1446.938
Maximum	2292.917
Minimum	121.6667
Std. Dev.	637.3863
Skewness	-0.272930
Kurtosis	1.685645
Jarque-Bera	30.80435
Probability	0.000000



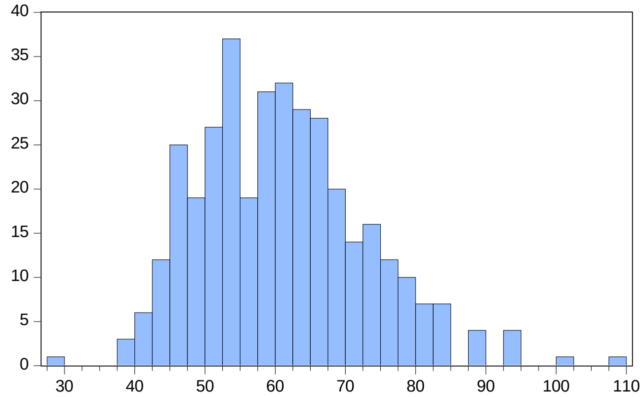
Series: WIND	
Sample 1 365	
Observations 365	
Mean	9.194543
Median	5.500000
Maximum	47.29167
Minimum	1.000000
Std. Dev.	10.85751
Skewness	2.322834
Kurtosis	7.729318
Jarque-Bera	668.3861
Probability	0.000000



Series: GAS_PRICE
Sample 1 365
Observations 362

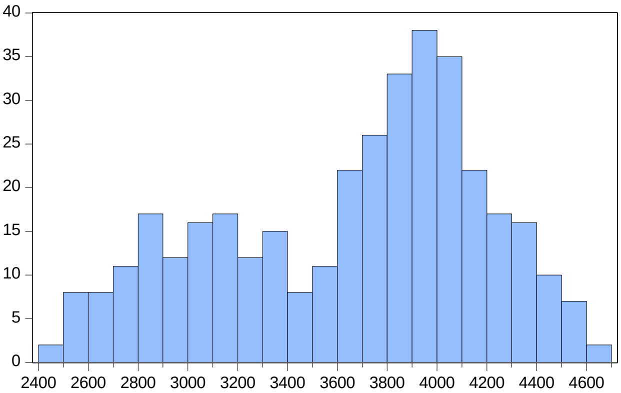
Mean	24.27869
Median	24.15750
Maximum	52.29500
Minimum	18.68600
Std. Dev.	3.665892
Skewness	2.415956
Kurtosis	16.76261
Jarque-Bera	3209.082
Probability	0.000000

CENTRAL NORTH



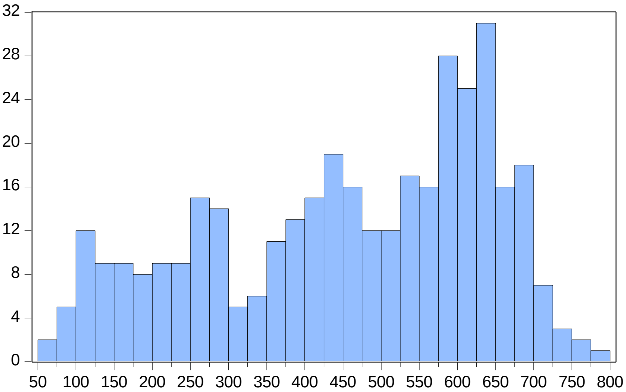
Series: PRICE
Sample 1 365
Observations 365

Mean	61.06357
Median	60.43586
Maximum	107.7766
Minimum	29.54730
Std. Dev.	11.87164
Skewness	0.586375
Kurtosis	3.464381
Jarque-Bera	24.19635
Probability	0.000006



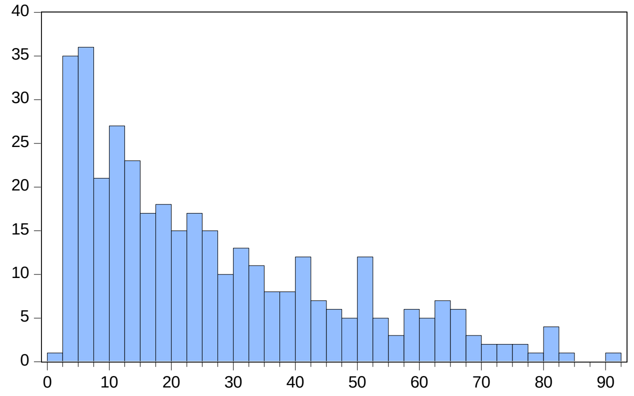
Series: LOAD
Sample 1 365
Observations 365

Mean	3658.058
Median	3785.833
Maximum	4632.792
Minimum	2474.667
Std. Dev.	532.5935
Skewness	-0.444624
Kurtosis	2.156169
Jarque-Bera	22.85528
Probability	0.000011

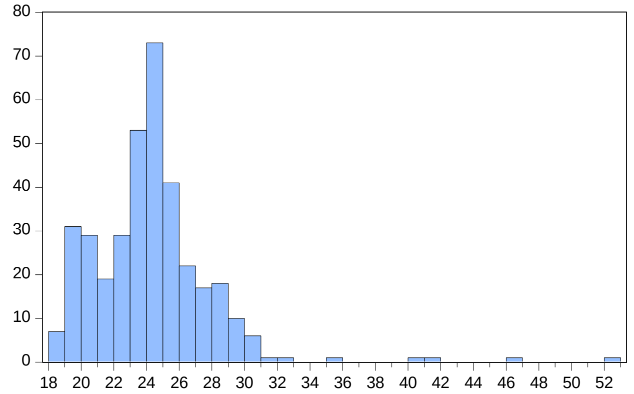


Series: SOLAR
Sample 1 365
Observations 365

Mean	456.3728
Median	483.4000
Maximum	791.6667
Minimum	55.28571
Std. Dev.	182.2728
Skewness	-0.444997
Kurtosis	2.050867
Jarque-Bera	25.74687
Probability	0.000003

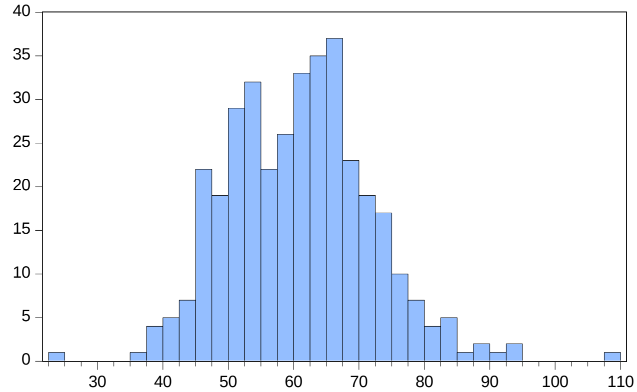


Series: WIND	
Sample 1 365	
Observations 365	
Mean	26.44031
Median	20.37500
Maximum	91.75000
Minimum	2.083333
Std. Dev.	20.43551
Skewness	0.918489
Kurtosis	2.975088
Jarque-Bera	51.32981
Probability	0.000000

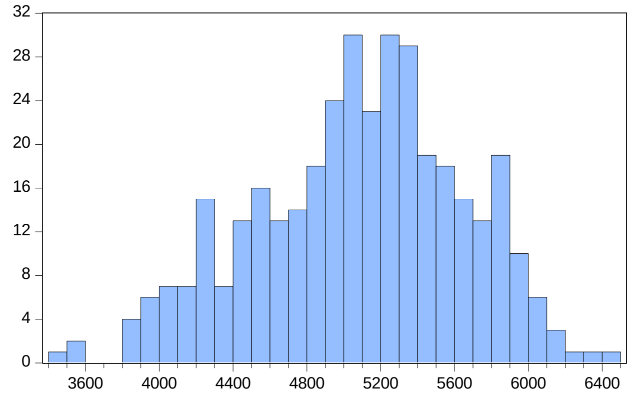


Series: GAS_PRICE	
Sample 1 365	
Observations 362	
Mean	24.27869
Median	24.15750
Maximum	52.29500
Minimum	18.68600
Std. Dev.	3.665892
Skewness	2.415956
Kurtosis	16.76261
Jarque-Bera	3209.082
Probability	0.000000

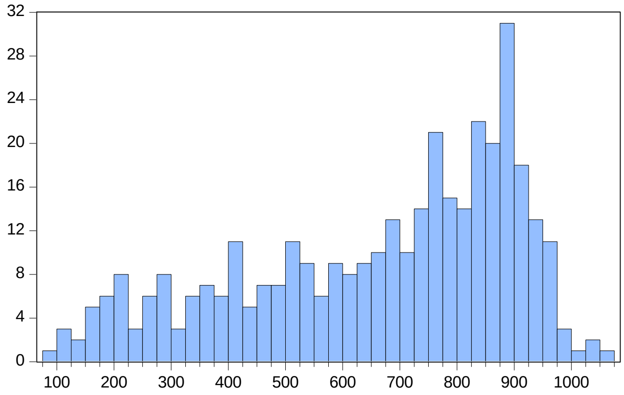
CENTRAL SOUTH



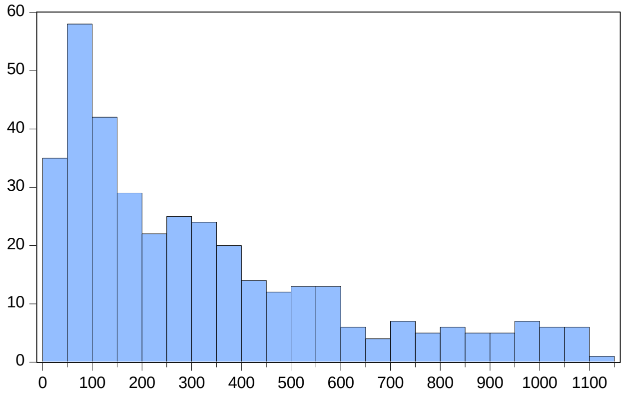
Series: PRICE	
Sample 1 365	
Observations 365	
Mean	60.93992
Median	61.34578
Maximum	107.7229
Minimum	22.78792
Std. Dev.	11.02542
Skewness	0.351928
Kurtosis	3.762799
Jarque-Bera	16.38359
Probability	0.000277



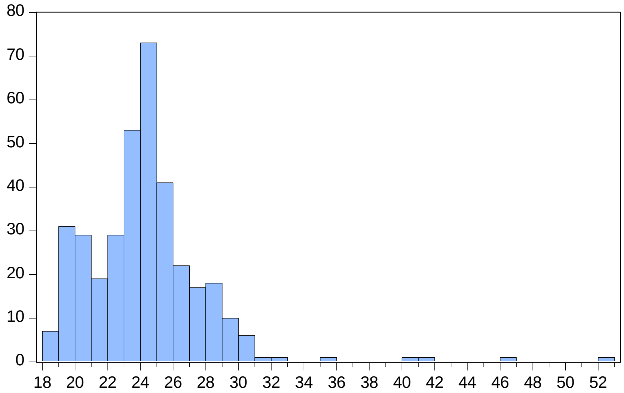
Series: LOAD	
Sample 1 365	
Observations 365	
Mean	5081.511
Median	5117.458
Maximum	6408.250
Minimum	3425.833
Std. Dev.	567.5984
Skewness	-0.298004
Kurtosis	2.640179
Jarque-Bera	7.371425
Probability	0.025079



Series: SOLAR	
Sample 1 365	
Observations 365	
Mean	662.1939
Median	733.3000
Maximum	1051.000
Minimum	97.30000
Std. Dev.	238.1364
Skewness	-0.634066
Kurtosis	2.288521
Jarque-Bera	32.15594
Probability	0.000000

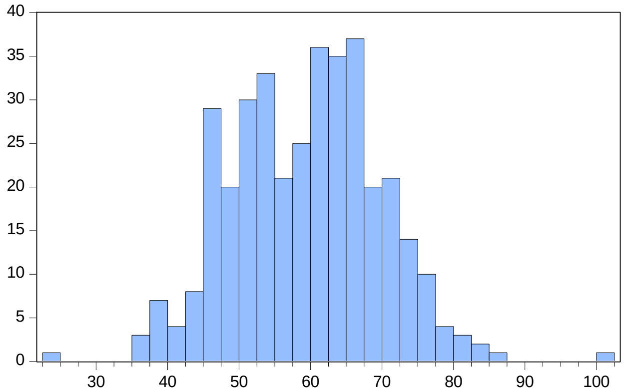


Series: WIND	
Sample 1 365	
Observations 365	
Mean	323.8256
Median	247.4583
Maximum	1108.958
Minimum	8.666667
Std. Dev.	282.2442
Skewness	1.096509
Kurtosis	3.303207
Jarque-Bera	74.54006
Probability	0.000000

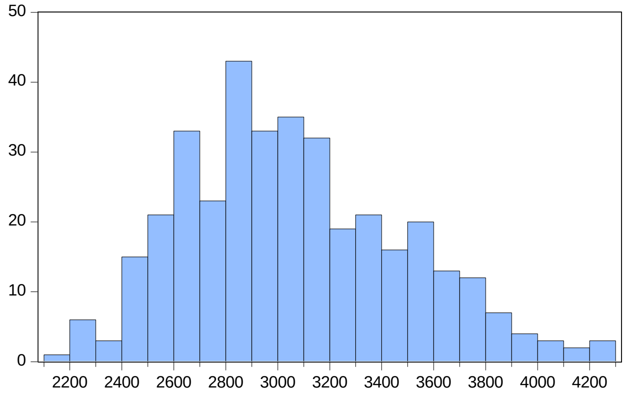


Series: GAS_PRICE	
Sample 1 365	
Observations 362	
Mean	24.27869
Median	24.15750
Maximum	52.29500
Minimum	18.68600
Std. Dev.	3.665892
Skewness	2.415956
Kurtosis	16.76261
Jarque-Bera	3209.082
Probability	0.000000

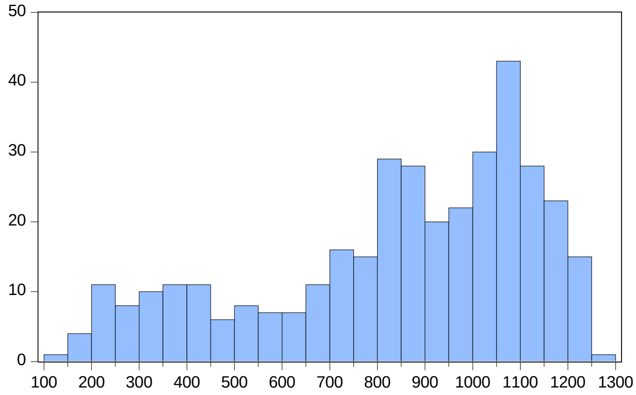
SOUTH



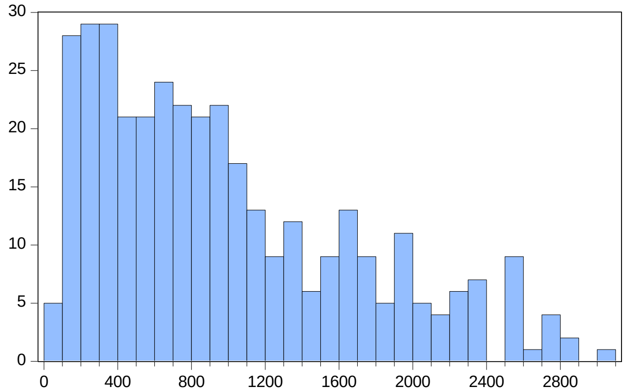
Series: PRICE	
Sample 1 365	
Observations 365	
Mean	59.37493
Median	60.18167
Maximum	102.0300
Minimum	22.78792
Std. Dev.	10.31943
Skewness	0.055517
Kurtosis	3.346923
Jarque-Bera	2.017899
Probability	0.364602



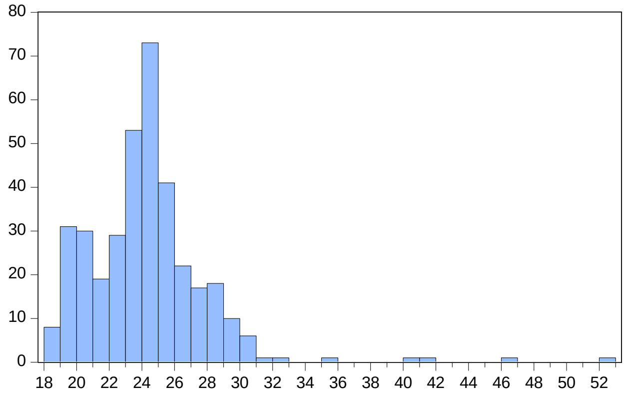
Series: LOAD	
Sample 1 365	
Observations 365	
Mean	3061.022
Median	3011.833
Maximum	4249.167
Minimum	2186.208
Std. Dev.	421.1353
Skewness	0.453954
Kurtosis	2.739942
Jarque-Bera	13.56472
Probability	0.001134



Series: SOLAR	
Sample 1 365	
Observations 365	
Mean	841.5041
Median	899.0000
Maximum	1272.643
Minimum	138.3636
Std. Dev.	287.5921
Skewness	-0.735504
Kurtosis	2.490354
Jarque-Bera	36.85900
Probability	0.000000

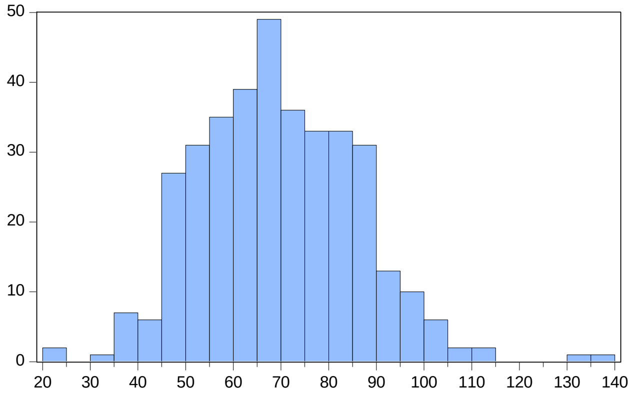


Series: WIND	
Sample 1 365	
Observations 365	
Mean	983.2319
Median	825.4583
Maximum	3018.708
Minimum	41.08333
Std. Dev.	700.3580
Skewness	0.830462
Kurtosis	2.816943
Jarque-Bera	42.46437
Probability	0.000000

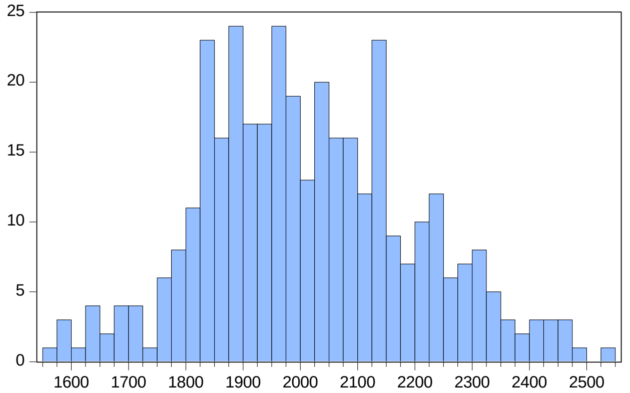


Series: GAS_PRICE	
Sample 1 365	
Observations 364	
Mean	24.25243
Median	24.14800
Maximum	52.29500
Minimum	18.68600
Std. Dev.	3.673123
Skewness	2.397217
Kurtosis	16.62478
Jarque-Bera	3164.090
Probability	0.000000

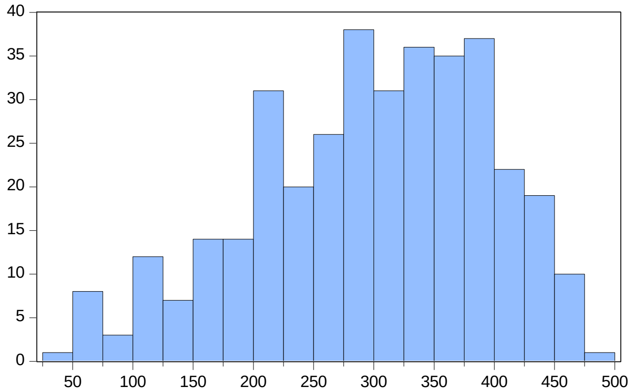
SICILY



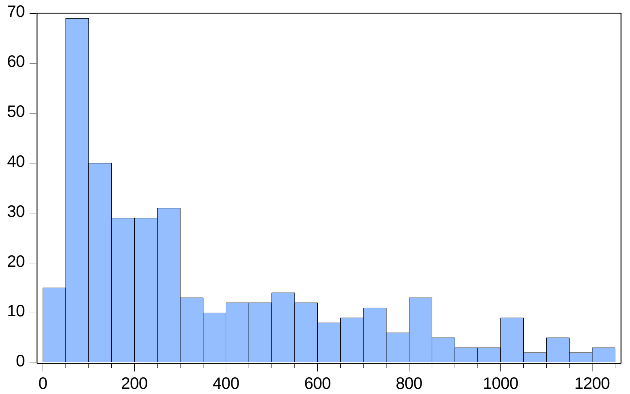
Series: PRICE	
Sample 1 365	
Observations 365	
Mean	69.48624
Median	68.54417
Maximum	135.8646
Minimum	22.78792
Std. Dev.	16.73624
Skewness	0.327676
Kurtosis	3.579456
Jarque-Bera	11.63827
Probability	0.002970



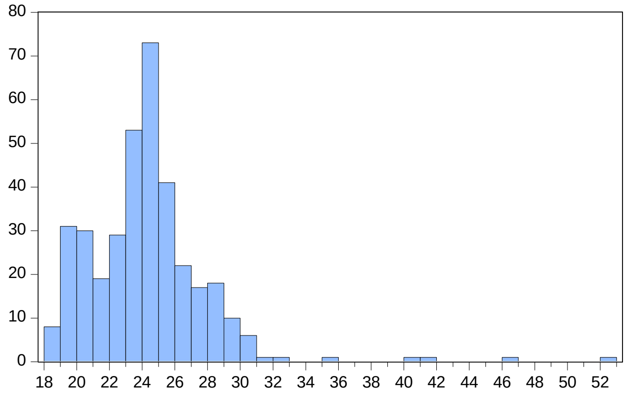
Series: LOAD	
Sample 1 365	
Observations 365	
Mean	2015.646
Median	1995.542
Maximum	2540.333
Minimum	1552.375
Std. Dev.	185.6830
Skewness	0.237149
Kurtosis	2.818329
Jarque-Bera	3.923193
Probability	0.140634



Series: SOLAR	
Sample 1 365	
Observations 365	
Mean	297.2585
Median	304.2000
Maximum	488.1538
Minimum	47.60000
Std. Dev.	97.09441
Skewness	-0.463395
Kurtosis	2.606250
Jarque-Bera	15.42093
Probability	0.000448

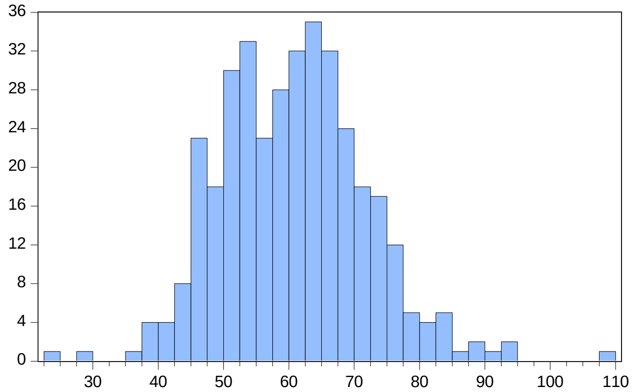


Series: WIND	
Sample 1 365	
Observations 365	
Mean	359.1374
Median	250.2083
Maximum	1221.083
Minimum	16.12500
Std. Dev.	305.0165
Skewness	1.021368
Kurtosis	3.033295
Jarque-Bera	63.47769
Probability	0.000000

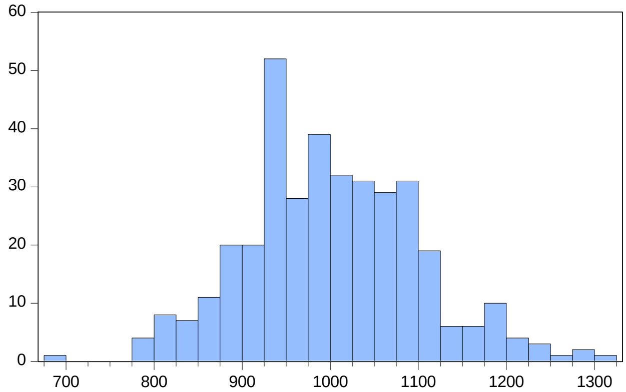


Series: GAS_PRICE	
Sample 1 365	
Observations 364	
Mean	24.25243
Median	24.14800
Maximum	52.29500
Minimum	18.68600
Std. Dev.	3.673123
Skewness	2.397217
Kurtosis	16.62478
Jarque-Bera	3164.090
Probability	0.000000

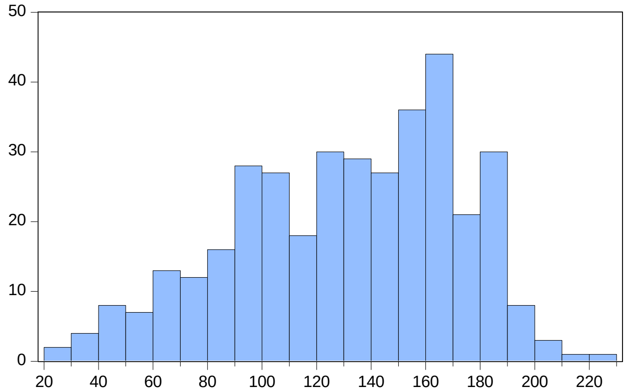
SARDINIA



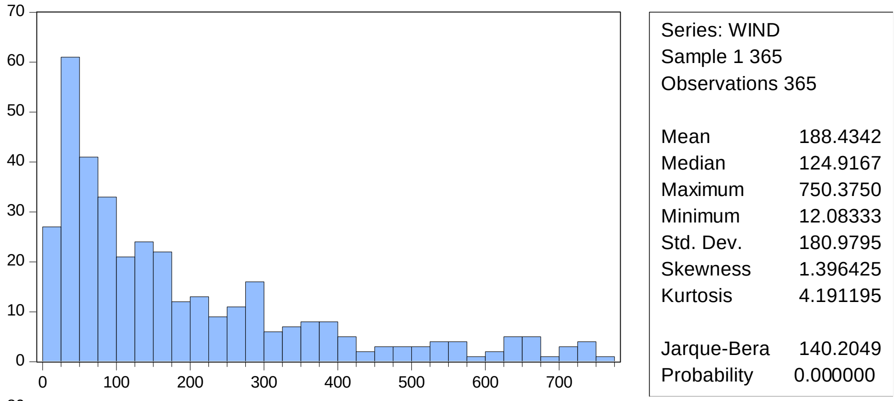
Series: PRICE	
Sample 1 365	
Observations 365	
Mean	60.69124
Median	60.93948
Maximum	107.7229
Minimum	22.78792
Std. Dev.	11.11699
Skewness	0.332821
Kurtosis	3.834545
Jarque-Bera	17.33056
Probability	0.000172

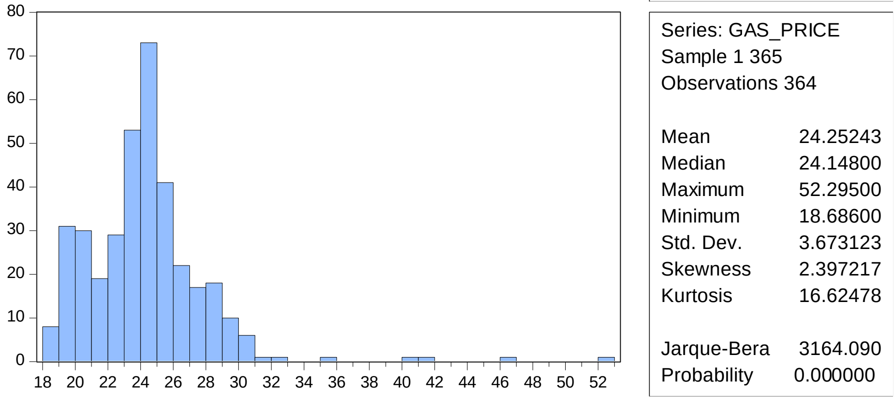


Series: LOAD	
Sample 1 365	
Observations 365	
Mean	1001.701
Median	996.0417
Maximum	1316.583
Minimum	692.6250
Std. Dev.	98.97019
Skewness	0.225721
Kurtosis	3.195253
Jarque-Bera	3.679255
Probability	0.158877

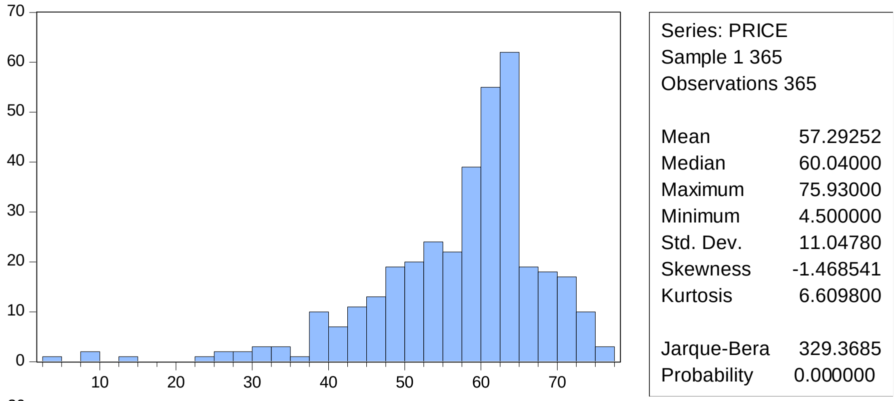


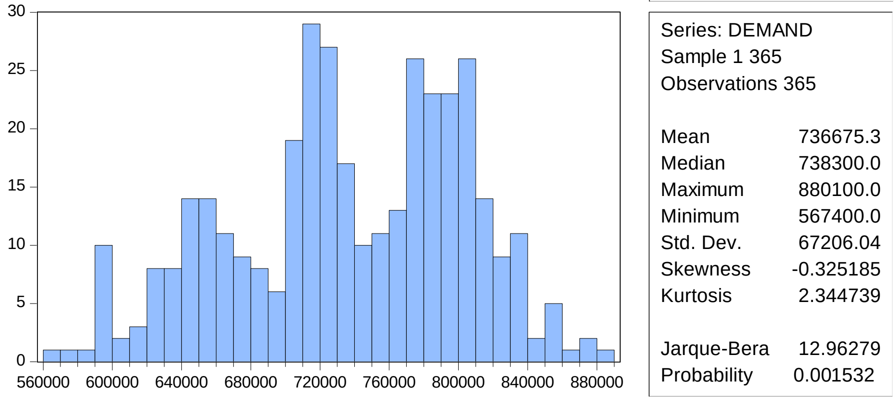
Series: SOLAR	
Sample 1 365	
Observations 365	
Mean	130.9516
Median	135.8462
Maximum	220.2727
Minimum	23.18182
Std. Dev.	41.06586
Skewness	-0.402648
Kurtosis	2.415140
Jarque-Bera	15.06482
Probability	0.000535

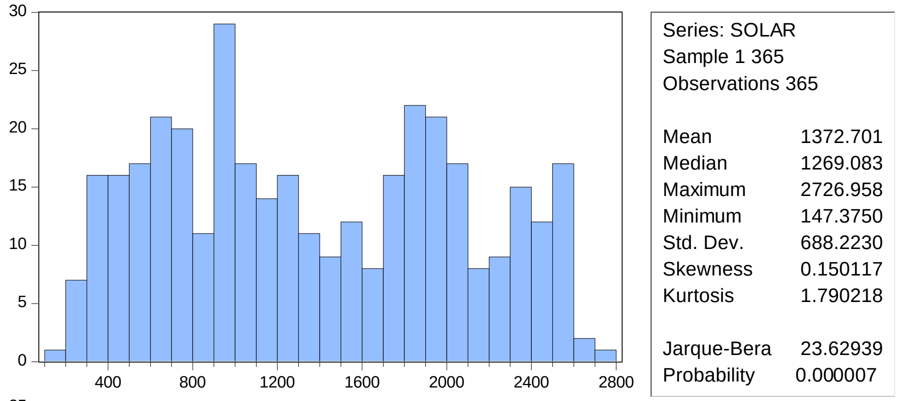
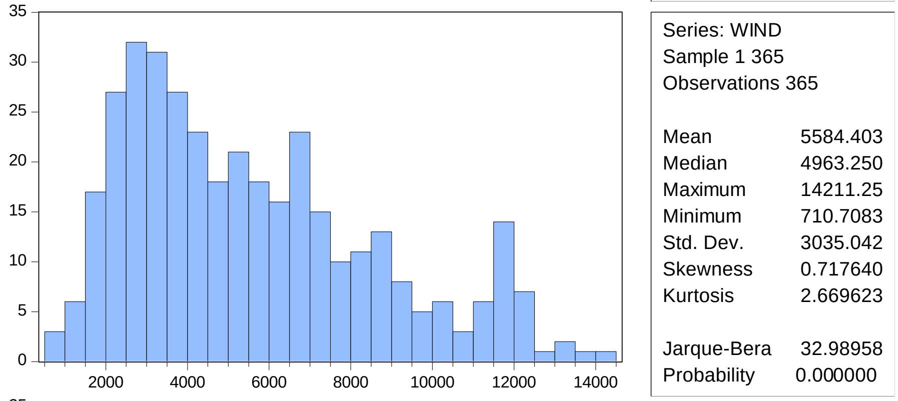
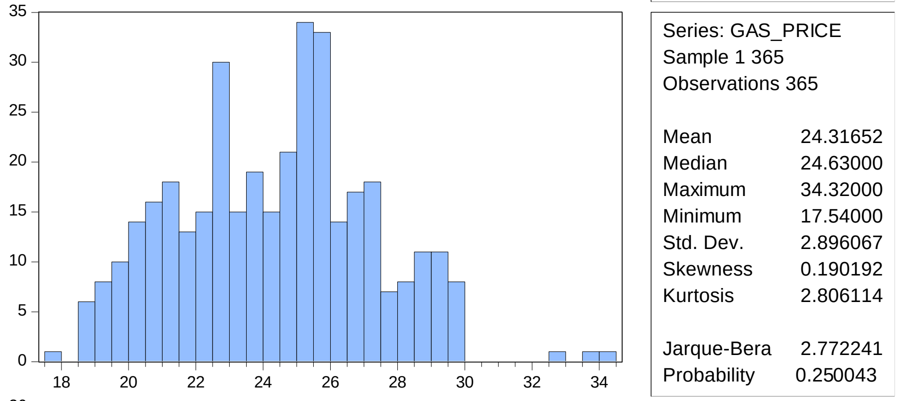
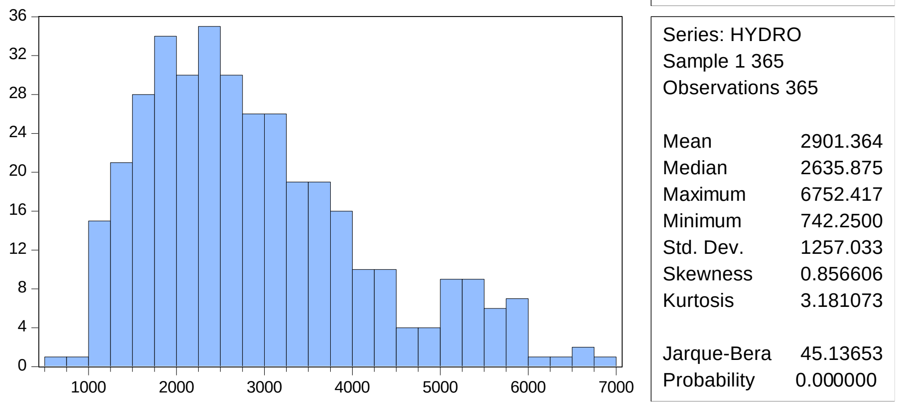

Series: WIND
Sample 1 365
Observations 365
Mean 188.4342
Median 124.9167
Maximum 750.3750
Minimum 12.08333
Std. Dev. 180.9795
Skewness 1.396425
Kurtosis 4.191195
Jarque-Bera 140.2049
Probability 0.000000


Series: GAS_PRICE
Sample 1 365
Observations 364
Mean 24.25243
Median 24.14800
Maximum 52.29500
Minimum 18.68600
Std. Dev. 3.673123
Skewness 2.397217
Kurtosis 16.62478
Jarque-Bera 3164.090
Probability 0.000000

SPAIN


Series: PRICE
Sample 1 365
Observations 365
Mean 57.29252
Median 60.04000
Maximum 75.93000
Minimum 4.500000
Std. Dev. 11.04780
Skewness -1.468541
Kurtosis 6.609800
Jarque-Bera 329.3685
Probability 0.000000


Series: DEMAND
Sample 1 365
Observations 365
Mean 736675.3
Median 738300.0
Maximum 880100.0
Minimum 567400.0
Std. Dev. 67206.04
Skewness -0.325185
Kurtosis 2.344739
Jarque-Bera 12.96279
Probability 0.001532


Series: SOLAR
Sample 1 365
Observations 365
Mean 1372.701
Median 1269.083
Maximum 2726.958
Minimum 147.3750
Std. Dev. 688.2230
Skewness 0.150117
Kurtosis 1.790218
Jarque-Bera 23.62939
Probability 0.000007

Series: WIND
Sample 1 365
Observations 365
Mean 5584.403
Median 4963.250
Maximum 14211.25
Minimum 710.7083
Std. Dev. 3035.042
Skewness 0.717640
Kurtosis 2.669623
Jarque-Bera 32.98958
Probability 0.000000

Series: GAS_PRICE
Sample 1 365
Observations 365
Mean 24.31652
Median 24.63000
Maximum 34.32000
Minimum 17.54000
Std. Dev. 2.896067
Skewness 0.190192
Kurtosis 2.806114
Jarque-Bera 2.772241
Probability 0.250043

Series: HYDRO
Sample 1 365
Observations 365
Mean 2901.364
Median 2635.875
Maximum 6752.417
Minimum 742.2500
Std. Dev. 1257.033
Skewness 0.856606
Kurtosis 3.181073
Jarque-Bera 45.13653
Probability 0.000000

SPEARMAN TEST

NORTH

Covariance Analysis: Spearman rank-order
Sample: 1 365
Included observations: 362

Correlation Probability	LOAD	SOLAR	WIND	GAS_PRICE
LOAD	1.000000 -----			
SOLAR	-0.059872 0.2559	1.000000 -----		
WIND	-0.046622 0.3765	-0.196021 0.0002	1.000000 -----	
GAS_PRICE	0.152068 0.0037	0.157306 0.0027	-0.195748 0.0002	1.000000 -----

CENTRAL NORTH

Covariance Analysis: Spearman rank-order
Sample: 1 365
Included observations: 362

Correlation Probability	LOAD	SOLAR	WIND	GAS_PRICE
LOAD	1.000000 -----			
SOLAR	-0.034885 0.5082	1.000000 -----		
WIND	0.069798 0.1852	-0.415187 0.0000	1.000000 -----	
GAS_PRICE	0.123209 0.0190	0.208011 0.0001	-0.093519 0.0756	1.000000 -----

CENTRAL SOUTH

Covariance Analysis: Spearman rank-order
Sample: 1 365
Included observations: 362

Correlation Probability	LOAD	SOLAR	WIND	GAS_PRICE
LOAD	1.000000 -----			
SOLAR	-0.091012 0.0838	1.000000 -----		
WIND	0.044007 0.4038	-0.223501 0.0000	1.000000 -----	
GAS_PRICE	0.064734 0.2192	0.162973 0.0019	-0.129645 0.0136	1.000000 -----

SOUTH

Covariance Analysis: Spearman rank-order
Sample: 1 365
Included observations: 364

Correlation Probability	LOAD	SOLAR	WIND	GAS_PRICE
LOAD	1.000000 -----			
SOLAR	0.168593 0.0012	1.000000 -----		
WIND	-0.084247 0.1086	-0.221560 0.0000	1.000000 -----	
GAS_PRICE	0.384726 0.0000	0.019571 0.7098	-0.142308 0.0065	1.000000 -----

SICILY

Covariance Analysis: Spearman rank-order
Sample: 1 365
Included observations: 364

Correlation Probability	LOAD	SOLAR	WIND	GAS_PRICE
LOAD	1.000000 -----			
SOLAR	0.099556 0.0577	1.000000 -----		
WIND	-0.121725 0.0202	-0.377141 0.0000	1.000000 -----	
GAS_PRICE	0.200207 0.0001	0.043136 0.4119	-0.223559 0.0000	1.000000 -----

SARDINIA

Covariance Analysis: Spearman rank-order
Sample: 1 365
Included observations: 364

Correlation Probability	LOAD	SOLAR	WIND	GAS_PRICE
LOAD	1.000000 -----			
SOLAR	-0.108584 0.0384	1.000000 -----		
WIND	-0.293840 0.0000	-0.249752 0.0000	1.000000 -----	
GAS_PRICE	0.191881 0.0002	0.121585 0.0203	-0.140225 0.0074	1.000000 -----

SPAIN

Covariance Analysis: Spearman rank-order
Sample: 1 365
Included observations: 365

Correlation Probability	DEMAND	SOLAR	WIND	HYDRO	GAS_PRICE
DEMAND	1.000000 -----				
SOLAR	-0.006453 0.9022	1.000000 -----			
WIND	0.118715 0.0233	-0.363190 0.0000	1.000000 -----		
HYDRO	0.251266 0.0000	0.122136 0.0196	-0.050734 0.3338	1.000000 -----	
GAS_PRICE	0.131907 0.0117	0.026210 0.6177	-0.247557 0.0000	-0.370557 0.0000	1.000000 -----

UNIT ROOT TEST

NORTH

UNIT ROOT TEST RESULTS TABLE (ADF)
Null Hypothesis: the variable has a unit root

	At Level					
		PRICE	LOAD	SOLAR	WIND	GAS_PRICE
With Constant	t-Statistic	-2.1516	-3.5936	-2.8467	-3.1056	-3.2645
	Prob.	***0.2248***	***0.0064***	***0.0529***	***0.0270***	***0.0174***
		n0	***	*	**	**

UNIT ROOT TEST RESULTS TABLE (PP)
Null Hypothesis: the variable has a unit root

	At Level					
		PRICE	LOAD	SOLAR	WIND	GAS_PRICE
With Constant	t-Statistic	-6.9078	-9.6788	-8.0080	-4.0038	-5.4072
	Prob.	***0.0000***	***0.0000***	***0.0000***	***0.0016***	***0.0000***
		***	***	***	***	***

CENTRAL NORTH

UNIT ROOT TEST RESULTS TABLE (ADF)
Null Hypothesis: the variable has a unit root

	At Level					
		PRICE	LOAD	SOLAR	WIND	GAS_PRICE
With Constant	t-Statistic	-2.1109	-3.1081	-1.7084	-5.0506	-3.2645
	Prob.	***0.2406***	***0.0269***	***0.4262***	***0.0000***	***0.0174***
		n0	**	n0	***	**

UNIT ROOT TEST RESULTS TABLE (PP)
Null Hypothesis: the variable has a unit root

	At Level					
		PRICE	LOAD	SOLAR	WIND	GAS_PRICE
With Constant	t-Statistic	-6.4643	-8.6862	-10.7333	-9.5777	-5.4072
	Prob.	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***0.0000***
		***	***	***	***	***

CENTRAL SOUTH

UNIT ROOT TEST RESULTS TABLE (ADF)
Null Hypothesis: the variable has a unit root

	At Level					
		PRICE	LOAD	SOLAR	WIND	GAS_PRICE
With Constant	t-Statistic	-2.4128	-3.1418	-2.3113	-10.4353	-3.2645
	Prob.	***0.1389***	***0.0245***	***0.1690***	***0.0000***	***0.0174***
		n0	**	n0	***	**

UNIT ROOT TEST RESULTS TABLE (PP)
Null Hypothesis: the variable has a unit root

	At Level					
		PRICE	LOAD	SOLAR	WIND	GAS_PRICE
With Constant	t-Statistic	-6.0654	-11.4956	-11.3196	-10.4238	-5.4072
	Prob.	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***0.0000***
		***	***	***	***	***

SOUTH

UNIT ROOT TEST RESULTS TABLE (ADF)
Null Hypothesis: the variable has a unit root

	At Level	PRICE	LOAD	SOLAR	WIND	GAS_PRICE
With Constant	t-Statistic	-2.6411	-1.8567	-3.7825	-10.1128	-2.9811
	Prob.	***0.0857***	***0.3528***	***0.0034***	***0.0000***	***0.0377***
		*	n0	***	***	**

UNIT ROOT TEST RESULTS TABLE (PP)
Null Hypothesis: the variable has a unit root

	At Level	PRICE	LOAD	SOLAR	WIND	GAS_PRICE
With Constant	t-Statistic	-6.5826	-7.5454	-11.2342	-10.0056	-5.3857
	Prob.	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***0.0000***
		***	***	***	***	***

SICILY

UNIT ROOT TEST RESULTS TABLE (ADF)
Null Hypothesis: the variable has a unit root

	At Level	PRICE	LOAD	SOLAR	WIND	GAS_PRICE
With Constant	t-Statistic	-3.7246	-2.4629	-1.8651	-5.1481	-2.9811
	Prob.	***0.0041***	***0.1256***	***0.3487***	***0.0000***	***0.0377***
		***	n0	n0	***	**

UNIT ROOT TEST RESULTS TABLE (PP)
Null Hypothesis: the variable has a unit root

	At Level	PRICE	LOAD	SOLAR	WIND	GAS_PRICE
With Constant	t-Statistic	-6.6389	-8.5996	-12.8396	-9.5087	-5.3857
	Prob.	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***0.0000***
		***	***	***	***	***

SARDINIA

UNIT ROOT TEST RESULTS TABLE (ADF)
Null Hypothesis: the variable has a unit root

	At Level	PRICE	LOAD	SOLAR	WIND	GAS_PRICE
With Constant	t-Statistic	-2.1769	-2.5275	-3.9842	-2.8046	-2.9811
	Prob.	***0.2152***	***0.1098***	***0.0017***	***0.0586***	***0.0377***
		n0	n0	***	*	**

UNIT ROOT TEST RESULTS TABLE (PP)
Null Hypothesis: the variable has a unit root

	At Level	PRICE	LOAD	SOLAR	WIND	GAS_PRICE
With Constant	t-Statistic	-6.0695	-7.5929	-12.0341	-10.1444	-5.3857
	Prob.	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***0.0000***
		***	***	***	***	***

SPAIN

UNIT ROOT TEST RESULTS TABLE (ADF)

Null Hypothesis: the variable has a unit root

		PRICE	DEMAND	SOLAR	WIND	HYDRO	GAS_PRICE
	At Level						
With Constant	t-Statistic	-1.7247	-2.2069	-2.3518	-2.8579	-1.9826	-1.6634
	Prob.	***0.4179***	***0.2043***	***0.1565***	***0.0514***	***0.2946***	***0.4490***
		n0	n0	n0	*	n0	n0

UNIT ROOT TEST RESULTS TABLE (PP)

Null Hypothesis: the variable has a unit root

		PRICE	DEMAND	SOLAR	WIND	HYDRO	GAS_PRICE
	At Level						
With Constant	t-Statistic	-6.1758	-14.0592	-4.4969	-7.6375	-5.5620	-2.5793
	Prob.	***0.0000***	***0.0000***	***0.0002***	***0.0000***	***0.0000***	***0.0982***
		***	***	***	***	***	*

RESULTS

NORTH

MODEL 1

Dependent Variable: PRICE
Method: Least Squares
Sample: 1 365
Included observations: 365
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	22.82470	2.988521	7.637457	0.0000
LOAD	0.001581	0.000125	12.65182	0.0000
DAY=2	1.014379	4.775469	0.212415	0.8319
DAY=3	-3.055967	3.558260	-0.858838	0.3911
DAY=4	-2.463384	3.346926	-0.736014	0.4623
DAY=5	-2.953840	3.547436	-0.832669	0.4056
DAY=6	-1.972222	3.481499	-0.566486	0.5715
DAY=7	-4.098495	3.526947	-1.162052	0.2461
DAY=8	-4.814854	3.330016	-1.445895	0.1492
DAY=9	-4.134983	3.404395	-1.214601	0.2254
DAY=10	-2.631593	3.428708	-0.767517	0.4433
DAY=11	-1.675287	3.453498	-0.485099	0.6279
DAY=12	-3.459316	3.551354	-0.974084	0.3307
DAY=13	-1.797177	3.422282	-0.525140	0.5998
DAY=14	-2.721071	3.354353	-0.811206	0.4178
DAY=15	-1.904845	3.195536	-0.596096	0.5515
DAY=16	-1.993136	3.193373	-0.624148	0.5330
DAY=17	0.007644	3.479852	0.002197	0.9982
DAY=18	-2.373596	3.200933	-0.741532	0.4589
DAY=19	-2.252258	3.330069	-0.676340	0.4993
DAY=20	-0.839569	3.388318	-0.247783	0.8045
DAY=21	1.187234	3.552815	0.334167	0.7385
DAY=22	0.782762	3.603404	0.217229	0.8282
DAY=23	-1.381033	3.453214	-0.399927	0.6895
DAY=24	-0.247309	3.443252	-0.071824	0.9428

DAY=25	-2.236562	3.120019	-0.716842	0.4740
DAY=26	0.668702	4.228427	0.158144	0.8744
DAY=27	2.437238	5.140436	0.474131	0.6357
DAY=28	-1.237721	3.951499	-0.313228	0.7543
DAY=29	-2.829155	3.258321	-0.868286	0.3859
DAY=30	-0.925536	3.409490	-0.271459	0.7862
DAY=31	-1.874771	3.673873	-0.510298	0.6102
MONTH="Aug"	16.43796	1.194223	13.76457	0.0000
MONTH="Dec"	14.08633	1.322491	10.65136	0.0000
MONTH="Feb"	3.132233	2.690950	1.163988	0.2453
MONTH="Jan"	-3.275203	1.430839	-2.289010	0.0227
MONTH="July"	6.439361	1.311872	4.908526	0.0000
MONTH="June"	3.114229	1.209949	2.573852	0.0105
MONTH="Mar"	6.069507	2.047423	2.964461	0.0033
MONTH="May"	1.276473	1.342470	0.950839	0.3424
MONTH="Nov"	15.02210	1.430823	10.49892	0.0000
MONTH="Oct"	24.00523	1.405674	17.07738	0.0000
MONTH="Sept"	24.54920	1.473213	16.66372	0.0000

R-squared	0.739316	Mean dependent var	60.71154
Adjusted R-squared	0.705314	S.D. dependent var	12.04913
S.E. of regression	6.540870	Akaike info criterion	6.704288
Sum squared resid	13776.12	Schwarz criterion	7.163728
Log likelihood	-1180.533	Hannan-Quinn criter.	6.886875
F-statistic	21.74315	Durbin-Watson stat	0.857818
Prob(F-statistic)	0.000000	Wald F-statistic	35.51127
Prob(Wald F-statistic)	0.000000		

Dependent Variable: PRICE
Method: ARMA Maximum Likelihood (OPG - BHHH)
Sample: 1 365
Included observations: 365
Convergence achieved after 37 iterations
Coefficient covariance computed using outer product of gradients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	23.13596	3.511917	6.587844	0.0000
LOAD	0.001592	0.000119	13.34071	0.0000
DAY=2	1.163305	1.208056	0.962956	0.3363
DAY=3	-2.825469	2.017261	-1.400646	0.1623
DAY=4	-2.179518	2.341444	-0.930843	0.3526
DAY=5	-2.650582	2.419864	-1.095344	0.2742
DAY=6	-1.646855	2.426921	-0.678578	0.4979
DAY=7	-3.755479	2.859120	-1.313508	0.1900
DAY=8	-4.461433	2.907844	-1.534275	0.1260
DAY=9	-3.783243	2.886284	-1.310766	0.1909
DAY=10	-2.276353	2.653859	-0.857752	0.3917
DAY=11	-1.318698	2.443199	-0.539742	0.5898
DAY=12	-3.113867	2.250951	-1.383356	0.1675
DAY=13	-1.443967	3.049924	-0.473444	0.6362
DAY=14	-2.359429	3.251217	-0.725706	0.4685
DAY=15	-1.541158	3.250043	-0.474196	0.6357
DAY=16	-1.634638	4.059170	-0.402702	0.6874
DAY=17	0.365297	3.131005	0.116671	0.9072
DAY=18	-2.018030	3.251868	-0.620576	0.5353
DAY=19	-1.913493	3.274400	-0.584380	0.5594
DAY=20	-0.501088	3.456256	-0.144980	0.8848
DAY=21	1.528842	2.845474	0.537289	0.5914
DAY=22	1.113704	2.466064	0.451612	0.6519
DAY=23	-1.073263	2.437376	-0.440335	0.6600
DAY=24	0.035230	2.717867	0.012962	0.9897
DAY=25	-2.002161	3.356360	-0.596527	0.5512
DAY=26	0.787834	2.573469	0.306137	0.7597
DAY=27	2.386991	2.535268	0.941514	0.3472
DAY=28	-1.571862	2.313592	-0.679403	0.4974

DAY=29	-1.369016	3.104318	-0.441004	0.6595
DAY=30	0.556461	2.569223	0.216587	0.8287
DAY=31	0.288132	2.294262	0.125588	0.9001
MONTH="Aug"	15.41857	3.661269	4.211263	0.0000
MONTH="Dec"	13.77108	3.537204	3.893210	0.0001
MONTH="Feb"	1.127930	3.029018	0.372375	0.7099
MONTH="Jan"	-3.092249	3.172853	-0.974596	0.3305
MONTH="July"	5.929330	3.771701	1.572057	0.1169
MONTH="June"	2.179723	4.149757	0.525265	0.5998
MONTH="Mar"	4.572783	3.113185	1.468844	0.1429
MONTH="May"	0.705967	3.574477	0.197502	0.8436
MONTH="Nov"	14.10686	3.921043	3.597731	0.0004
MONTH="Oct"	22.56812	3.979988	5.670400	0.0000
MONTH="Sept"	22.96966	3.489978	6.581606	0.0000
AR(1)	0.584123	0.038478	15.18087	0.0000
SIGMASQ	25.22061	1.700872	14.82804	0.0000

R-squared	0.825805	Mean dependent var	60.71154
Adjusted R-squared	0.801853	S.D. dependent var	12.04913
S.E. of regression	5.363511	Akaike info criterion	6.313257
Sum squared resid	9205.522	Schwarz criterion	6.794066
Log likelihood	-1107.169	Hannan-Quinn criter.	6.504337
F-statistic	34.47776	Durbin-Watson stat	2.207998
Prob(F-statistic)	0.000000		

Inverted AR Roots	.58

MODEL 2

Dependent Variable: PRICE
Method: Least Squares
Sample: 1 365
Included observations: 365
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	26.84924	3.086853	8.697935	0.0000
LOAD	0.001585	0.000122	13.00014	0.0000
RES	-0.003346	0.000711	-4.707855	0.0000
DAY=2	1.328601	4.711090	0.282016	0.7781
DAY=3	-2.442038	3.553855	-0.687152	0.4925
DAY=4	-1.345960	3.219923	-0.418010	0.6762
DAY=5	-2.042934	3.456863	-0.590979	0.5550
DAY=6	-1.716346	3.405310	-0.504021	0.6146
DAY=7	-3.413236	3.465580	-0.984896	0.3254
DAY=8	-3.418854	3.184051	-1.073743	0.2837
DAY=9	-2.758045	3.277584	-0.841487	0.4007
DAY=10	-1.406307	3.391058	-0.414711	0.6786
DAY=11	-1.156692	3.265318	-0.354236	0.7234
DAY=12	-2.565633	3.524116	-0.728022	0.4671
DAY=13	-0.581230	3.289518	-0.176692	0.8599
DAY=14	-0.925897	3.246883	-0.285165	0.7757
DAY=15	-1.007056	3.126677	-0.322085	0.7476
DAY=16	-0.785281	3.129112	-0.250960	0.8020
DAY=17	1.034522	3.359302	0.307957	0.7583
DAY=18	-1.081334	3.201650	-0.337743	0.7358
DAY=19	-0.819413	3.223874	-0.254170	0.7995
DAY=20	0.526314	3.284246	0.160254	0.8728
DAY=21	2.816553	3.509702	0.802505	0.4229
DAY=22	2.009910	3.591836	0.559577	0.5762
DAY=23	-0.031484	3.263862	-0.009646	0.9923
DAY=24	1.266119	3.379846	0.374608	0.7082
DAY=25	-1.089940	3.046232	-0.357799	0.7207

DAY=26	2.312379	4.264649	0.542220	0.5880
DAY=27	3.607033	5.138628	0.701945	0.4832
DAY=28	0.023288	3.924368	0.005934	0.9953
DAY=29	-1.913293	3.259003	-0.587079	0.5576
DAY=30	0.076279	3.436485	0.022197	0.9823
DAY=31	-1.413373	3.726251	-0.379302	0.7047
MONTH="Aug"	17.45466	1.049004	16.63927	0.0000
MONTH="Dec"	11.09912	1.361040	8.154882	0.0000
MONTH="Feb"	0.697716	2.659215	0.262377	0.7932
MONTH="Jan"	-5.552641	1.296305	-4.283438	0.0000
MONTH="July"	7.449842	1.161482	6.414083	0.0000
MONTH="June"	4.200654	1.051401	3.995292	0.0001
MONTH="Mar"	3.854938	1.798072	2.143929	0.0328
MONTH="May"	1.538647	1.276209	1.205639	0.2288
MONTH="Nov"	12.16783	1.374700	8.851264	0.0000
MONTH="Oct"	23.09686	1.328790	17.38187	0.0000
MONTH="Sept"	25.53407	1.355489	18.83754	0.0000

R-squared	0.751753	Mean dependent var	60.71154
Adjusted R-squared	0.718498	S.D. dependent var	12.04913
S.E. of regression	6.392875	Akaike info criterion	6.660885
Sum squared resid	13118.90	Schwarz criterion	7.131009
Log likelihood	-1171.611	Hannan-Quinn criter.	6.847718
F-statistic	22.60616	Durbin-Watson stat	0.889447
Prob(F-statistic)	0.000000	Wald F-statistic	39.01797
Prob(Wald F-statistic)	0.000000		

Dependent Variable: PRICE
Method: ARMA Conditional Least Squares (Gauss-Newton / Marquardt steps)
Sample (adjusted): 2 365
Included observations: 364 after adjustments
Convergence achieved after 7 iterations
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	25.59284	3.409239	7.506907	0.0000
LOAD	0.001588	0.000112	14.20701	0.0000
RES	-0.002280	0.000680	-3.350779	0.0009
DAY=2	1.619845	2.597929	0.623514	0.5334
DAY=3	-2.024094	2.581443	-0.784094	0.4336
DAY=4	-0.958604	2.639726	-0.363145	0.7167
DAY=5	-1.520264	2.805787	-0.541831	0.5883
DAY=6	-0.940585	2.815191	-0.334111	0.7385
DAY=7	-2.746816	2.700114	-1.017296	0.3098
DAY=8	-2.963067	2.678884	-1.106083	0.2695
DAY=9	-2.290363	2.705114	-0.846679	0.3978
DAY=10	-0.885100	2.895572	-0.305674	0.7601
DAY=11	-0.407622	2.979509	-0.136808	0.8913
DAY=12	-1.939586	3.337514	-0.581147	0.5616
DAY=13	-0.053934	2.854054	-0.018897	0.9849
DAY=14	-0.579273	2.691913	-0.215190	0.8298
DAY=15	-0.373530	2.590308	-0.144203	0.8854
DAY=16	-0.252834	2.474671	-0.102169	0.9187
DAY=17	1.623961	2.805973	0.578752	0.5632
DAY=18	-0.577983	2.707917	-0.213442	0.8311
DAY=19	-0.369147	2.660681	-0.138741	0.8897
DAY=20	0.995654	2.602553	0.382568	0.7023
DAY=21	3.199472	2.849484	1.122825	0.2624
DAY=22	2.509740	3.299581	0.760624	0.4474
DAY=23	0.407674	3.077770	0.132458	0.8947
DAY=24	1.621422	2.872523	0.564459	0.5728
DAY=25	-0.675115	2.620876	-0.257591	0.7969
DAY=26	2.454839	3.507572	0.699868	0.4845

DAY=27	3.713801	3.544496	1.047766	0.2955
DAY=28	-0.221881	2.971446	-0.074671	0.9405
DAY=29	-0.338972	2.448811	-0.138423	0.8900
DAY=30	1.529678	2.091699	0.731309	0.4651
DAY=31	0.937798	2.247939	0.417181	0.6768
MONTH="Aug"	15.97010	2.386450	6.691989	0.0000
MONTH="Dec"	11.80268	2.734190	4.316701	0.0000
MONTH="Feb"	-0.567642	4.297180	-0.132096	0.8950
MONTH="Jan"	-5.558414	3.023423	-1.838451	0.0669
MONTH="July"	6.584347	2.422601	2.717883	0.0069
MONTH="June"	2.832073	2.177851	1.300398	0.1944
MONTH="Mar"	2.974881	3.312007	0.898211	0.3698
MONTH="May"	0.556754	2.373775	0.234544	0.8147
MONTH="Nov"	11.96925	2.600077	4.603423	0.0000
MONTH="Oct"	21.81667	2.472922	8.822222	0.0000
MONTH="Sept"	23.72003	2.756256	8.605888	0.0000
AR(1)	0.573684	0.093003	6.168412	0.0000

R-squared	0.830437	Mean dependent var	60.75378
Adjusted R-squared	0.807049	S.D. dependent var	12.03863
S.E. of regression	5.288104	Akaike info criterion	6.284087
Sum squared resid	8920.531	Schwarz criterion	6.765878
Log likelihood	-1098.704	Hannan-Quinn criter.	6.475576
F-statistic	35.50706	Durbin-Watson stat	2.176024
Prob(F-statistic)	0.000000		

Inverted AR Roots	.57

MODEL 3

Dependent Variable: PRICE
Method: Least Squares
Sample: 1 365
Included observations: 365
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	27.64515	2.942422	9.395373	0.0000
LOAD	0.001578	0.000121	13.01969	0.0000
SOLAR	-0.003424	0.000704	-4.861613	0.0000
WIND	-0.094676	0.076536	-1.237018	0.2170
DAY=2	1.356666	4.686424	0.289488	0.7724
DAY=3	-2.463234	3.533335	-0.697141	0.4862
DAY=4	-1.357240	3.216422	-0.421972	0.6733
DAY=5	-2.109715	3.433599	-0.614432	0.5394
DAY=6	-1.876430	3.367848	-0.557160	0.5778
DAY=7	-3.619578	3.423177	-1.057374	0.2911
DAY=8	-3.624858	3.138761	-1.154869	0.2490
DAY=9	-2.792675	3.257258	-0.857370	0.3919
DAY=10	-1.382262	3.358133	-0.411616	0.6809
DAY=11	-1.249915	3.250672	-0.384510	0.7009
DAY=12	-2.590622	3.488501	-0.742618	0.4583
DAY=13	-0.493015	3.270607	-0.150741	0.8803
DAY=14	-0.862596	3.239132	-0.266305	0.7902
DAY=15	-0.960555	3.123871	-0.307489	0.7587
DAY=16	-0.693508	3.122319	-0.222113	0.8244
DAY=17	1.177535	3.360913	0.350362	0.7263
DAY=18	-0.914597	3.206475	-0.285234	0.7756
DAY=19	-0.830461	3.206447	-0.258997	0.7958
DAY=20	0.657555	3.295479	0.199532	0.8420
DAY=21	3.016388	3.510567	0.859231	0.3909
DAY=22	2.121576	3.587242	0.591422	0.5547
DAY=23	0.034158	3.267596	0.010453	0.9917

DAY=24	1.415943	3.392960	0.417318	0.6767
DAY=25	-0.800724	3.092403	-0.258932	0.7959
DAY=26	2.469218	4.279951	0.576927	0.5644
DAY=27	3.557910	5.110102	0.696250	0.4868
DAY=28	0.006176	3.883928	0.001590	0.9987
DAY=29	-1.855435	3.232278	-0.574033	0.5663
DAY=30	0.223347	3.441650	0.064895	0.9483
DAY=31	-1.356500	3.677968	-0.368818	0.7125
MONTH="Aug"	17.20569	1.076610	15.98136	0.0000
MONTH="Dec"	10.99700	1.354368	8.119656	0.0000
MONTH="Feb"	0.819652	2.666072	0.307438	0.7587
MONTH="Jan"	-5.438905	1.300624	-4.181765	0.0000
MONTH="July"	7.154003	1.206294	5.930563	0.0000
MONTH="June"	7.474639	2.901924	2.575753	0.0105
MONTH="Mar"	4.077180	1.827309	2.231248	0.0264
MONTH="May"	1.383199	1.286005	1.075578	0.2829
MONTH="Nov"	12.19936	1.393126	8.756823	0.0000
MONTH="Oct"	23.17705	1.307893	17.72090	0.0000
MONTH="Sept"	25.42297	1.363934	18.63944	0.0000

R-squared	0.752682	Mean dependent var	60.71154
Adjusted R-squared	0.718676	S.D. dependent var	12.04913
S.E. of regression	6.390858	Akaike info criterion	6.662613
Sum squared resid	13069.78	Schwarz criterion	7.143422
Log likelihood	-1170.927	Hannan-Quinn criter.	6.853693
F-statistic	22.13366	Durbin-Watson stat	0.894585
Prob(F-statistic)	0.000000	Wald F-statistic	37.70695
Prob(Wald F-statistic)	0.000000		

Dependent Variable: PRICE
Method: ARMA Conditional Least Squares (Gauss-Newton / Marquardt steps)
Sample (adjusted): 2 365
Included observations: 364 after adjustments
Convergence achieved after 7 iterations
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	25.94298	3.437415	7.547235	0.0000
LOAD	0.001586	0.000112	14.15129	0.0000
SOLAR	-0.002319	0.000690	-3.358849	0.0009
WIND	-0.044122	0.074891	-0.589151	0.5562
DAY=2	1.641048	2.591636	0.633209	0.5271
DAY=3	-2.021476	2.582564	-0.782740	0.4344
DAY=4	-0.948689	2.654322	-0.357413	0.7210
DAY=5	-1.535757	2.813325	-0.545887	0.5855
DAY=6	-0.998632	2.810935	-0.355267	0.7226
DAY=7	-2.824824	2.688323	-1.050775	0.2942
DAY=8	-3.039767	2.663747	-1.141162	0.2547
DAY=9	-2.288930	2.707817	-0.845304	0.3986
DAY=10	-0.856813	2.900868	-0.295364	0.7679
DAY=11	-0.433749	2.980572	-0.145525	0.8844
DAY=12	-1.934981	3.329340	-0.581191	0.5615
DAY=13	0.003423	2.849666	0.001201	0.9990
DAY=14	-0.532109	2.697045	-0.197293	0.8437
DAY=15	-0.334794	2.603578	-0.128590	0.8978
DAY=16	-0.193407	2.494235	-0.077542	0.9382
DAY=17	1.706684	2.829857	0.603099	0.5469
DAY=18	-0.484163	2.744887	-0.176387	0.8601
DAY=19	-0.357706	2.662994	-0.134325	0.8932
DAY=20	1.072541	2.633865	0.407212	0.6841
DAY=21	3.308876	2.882391	1.147962	0.2518
DAY=22	2.578523	3.338574	0.772342	0.4405
DAY=23	0.455376	3.103416	0.146734	0.8834

DAY=24	1.708679	2.914182	0.586332	0.5581
DAY=25	-0.523464	2.697134	-0.194081	0.8462
DAY=26	2.545156	3.531056	0.720792	0.4716
DAY=27	3.708979	3.546496	1.045815	0.2964
DAY=28	-0.212743	2.977606	-0.071448	0.9431
DAY=29	-0.294090	2.464948	-0.119309	0.9051
DAY=30	1.619754	2.128130	0.761116	0.4472
DAY=31	0.977549	2.258704	0.432792	0.6655
MONTH="Aug"	15.84379	2.395586	6.613744	0.0000
MONTH="Dec"	11.73645	2.742055	4.280166	0.0000
MONTH="Feb"	-0.499435	4.271599	-0.116920	0.9070
MONTH="Jan"	-5.557098	3.001160	-1.851650	0.0650
MONTH="July"	6.430455	2.442034	2.633238	0.0089
MONTH="June"	4.302339	3.341733	1.287457	0.1989
MONTH="Mar"	3.083411	3.297633	0.935038	0.3505
MONTH="May"	0.461652	2.388692	0.193266	0.8469
MONTH="Nov"	11.96703	2.601563	4.599938	0.0000
MONTH="Oct"	21.83555	2.460249	8.875340	0.0000
MONTH="Sept"	23.66305	2.746115	8.616919	0.0000
AR(1)	0.572427	0.092616	6.180632	0.0000

R-squared	0.830573	Mean dependent var	60.75378
Adjusted R-squared	0.806598	S.D. dependent var	12.03863
S.E. of regression	5.294287	Akaike info criterion	6.288778
Sum squared resid	8913.372	Schwarz criterion	6.781276
Log likelihood	-1098.558	Hannan-Quinn criter.	6.484524
F-statistic	34.64265	Durbin-Watson stat	2.180291
Prob(F-statistic)	0.000000		

Inverted AR Roots	.57

MODEL 4

Dependent Variable: PRICE
Method: Least Squares
Sample: 1 365
Included observations: 362
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-4.714922	4.145280	-1.137419	0.2562
LOAD	0.001188	7.79E-05	15.23634	0.0000
SOLAR	-0.002875	0.000558	-5.152769	0.0000
WIND	-0.092227	0.056977	-1.618657	0.1065
GAS_PRICE	1.660478	0.172469	9.627685	0.0000
DAY=2	0.583599	2.311645	0.252460	0.8008
DAY=3	-0.624400	1.742265	-0.358384	0.7203
DAY=4	1.624166	1.719389	0.944618	0.3456
DAY=5	0.023377	1.476584	0.015832	0.9874
DAY=6	1.665989	1.571934	1.059834	0.2900
DAY=7	-0.097710	1.703609	-0.057355	0.9543
DAY=8	-0.516896	1.543791	-0.334823	0.7380
DAY=9	0.583359	1.600367	0.364516	0.7157
DAY=10	1.692695	1.733592	0.976409	0.3296
DAY=11	1.770865	1.860481	0.951832	0.3419
DAY=12	0.663553	1.662624	0.399100	0.6901
DAY=13	2.116490	1.728064	1.224775	0.2216
DAY=14	1.185963	1.679295	0.706227	0.4806
DAY=15	1.244111	1.413631	0.880081	0.3795
DAY=16	1.418539	1.400304	1.013022	0.3118
DAY=17	3.362032	1.845337	1.821906	0.0694
DAY=18	1.243127	1.570029	0.791786	0.4291
DAY=19	1.329261	1.424902	0.932879	0.3516

DAY=20	2.923066	1.613953	1.811122	0.0711
DAY=21	4.690603	2.034407	2.305637	0.0218
DAY=22	3.494629	2.298831	1.520177	0.1295
DAY=23	1.649694	1.621018	1.017690	0.3096
DAY=24	3.198270	1.731692	1.846904	0.0657
DAY=25	0.457071	1.390191	0.328783	0.7425
DAY=26	1.602174	1.824785	0.878007	0.3806
DAY=27	3.872417	2.237652	1.730571	0.0845
DAY=28	0.732311	1.700585	0.430623	0.6670
DAY=29	1.017983	1.601790	0.635528	0.5255
DAY=30	2.871544	1.892797	1.517091	0.1302
DAY=31	1.640045	1.994947	0.822100	0.4116
MONTH="Aug"	11.41636	1.152441	9.906246	0.0000
MONTH="Dec"	6.243859	1.400892	4.457058	0.0000
MONTH="Feb"	1.040508	1.407164	0.739436	0.4602
MONTH="Jan"	-0.993607	1.262835	-0.786807	0.4320
MONTH="July"	4.360525	1.152036	3.785060	0.0002
MONTH="June"	4.805944	2.257129	2.129229	0.0340
MONTH="Mar"	2.630457	1.278225	2.057899	0.0404
MONTH="May"	-0.753871	1.189073	-0.633998	0.5265
MONTH="Nov"	8.393565	1.440899	5.825227	0.0000
MONTH="Oct"	15.09302	1.398306	10.79379	0.0000
MONTH="Sept"	14.10710	1.688725	8.353701	0.0000

R-squared	0.888944	Mean dependent var	60.82267
Adjusted R-squared	0.873129	S.D. dependent var	12.02631
S.E. of regression	4.283640	Akaike info criterion	5.865725
Sum squared resid	5798.465	Schwarz criterion	6.360243
Log likelihood	-1015.696	Hannan-Quinn criter.	6.062314
F-statistic	56.20923	Durbin-Watson stat	1.615639
Prob(F-statistic)	0.000000	Wald F-statistic	54.19303
Prob(Wald F-statistic)	0.000000		

Dependent Variable: PRICE
Method: ARMA Conditional Least Squares (Gauss-Newton / Marquardt steps)
Sample (adjusted): 4 365
Included observations: 358 after adjustments
Convergence achieved after 5 iterations
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-4.755340	4.409260	-1.078489	0.2817
LOAD	0.001221	8.33E-05	14.65442	0.0000
SOLAR	-0.002683	0.000586	-4.582629	0.0000
WIND	-0.090952	0.061953	-1.468083	0.1431
GAS_PRICE	1.608028	0.185746	8.657111	0.0000
DAY=2	0.991386	2.103574	0.471286	0.6378
DAY=3	-0.944939	1.577179	-0.599133	0.5495
DAY=4	1.248557	1.785357	0.699332	0.4849
DAY=5	0.141383	1.495924	0.094512	0.9248
DAY=6	1.872823	1.551026	1.207473	0.2282
DAY=7	0.111614	1.635254	0.068255	0.9456
DAY=8	-0.328284	1.540738	-0.213070	0.8314
DAY=9	0.753046	1.617674	0.465512	0.6419
DAY=10	1.883292	1.773917	1.061657	0.2892
DAY=11	2.008916	1.936866	1.037199	0.3004
DAY=12	0.847871	1.803810	0.470045	0.6387
DAY=13	2.313618	1.662973	1.391254	0.1651
DAY=14	1.380699	1.596253	0.864963	0.3877
DAY=15	1.494066	1.406301	1.062408	0.2889
DAY=16	1.642513	1.368384	1.200330	0.2309
DAY=17	3.594131	1.855441	1.937076	0.0536
DAY=18	1.457790	1.579170	0.923137	0.3567

DAY=19	1.510093	1.409860	1.071094	0.2850
DAY=20	3.109744	1.590335	1.955401	0.0514
DAY=21	4.897141	1.977004	2.477052	0.0138
DAY=22	3.738368	2.308392	1.619469	0.1064
DAY=23	1.872168	1.576636	1.187444	0.2360
DAY=24	3.420068	1.705992	2.004739	0.0459
DAY=25	0.734416	1.411067	0.520468	0.6031
DAY=26	1.886421	1.776828	1.061679	0.2892
DAY=27	4.151388	2.257828	1.838664	0.0669
DAY=28	1.006164	1.637722	0.614368	0.5394
DAY=29	1.371833	1.494978	0.917628	0.3595
DAY=30	3.684199	1.739078	2.118478	0.0349
DAY=31	1.925732	1.738635	1.107611	0.2689
MONTH="Aug"	11.59876	1.310553	8.850283	0.0000
MONTH="Dec"	6.762089	1.624059	4.163696	0.0000
MONTH="Feb"	1.242011	1.724703	0.720130	0.4720
MONTH="Jan"	-1.131683	1.482439	-0.763393	0.4458
MONTH="July"	4.441304	1.327989	3.344384	0.0009
MONTH="June"	4.823841	2.486087	1.940335	0.0532
MONTH="Mar"	2.783103	1.540044	1.807157	0.0717
MONTH="May"	-0.604073	1.391053	-0.434256	0.6644
MONTH="Nov"	8.696968	1.649301	5.273125	0.0000
MONTH="Oct"	15.43736	1.570684	9.828426	0.0000
MONTH="Sept"	14.48297	1.852899	7.816387	0.0000
AR(1)	0.177037	0.063090	2.806081	0.0053

R-squared	0.894395	Mean dependent var	60.93280
Adjusted R-squared	0.878775	S.D. dependent var	12.03389
S.E. of regression	4.189889	Akaike info criterion	5.825055
Sum squared resid	5459.657	Schwarz criterion	6.334511
Log likelihood	-995.6849	Hannan-Quinn criter.	6.027666
F-statistic	57.25940	Durbin-Watson stat	1.965644
Prob(F-statistic)	0.000000		

Inverted AR Roots	.18

TEST ON THE RESIDUALS

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.008474	Prob. F(2,309)	0.9916
Obs*R-squared	0.019636	Prob. Chi-Square(2)	0.9902

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Sample: 4 365
Included observations: 358
Coefficient covariance computed using outer product of gradients
Presample and interior missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.003833	2.868746	-0.001336	0.9989
LOAD	-6.31E-07	8.40E-05	-0.007513	0.9940
SOLAR	-9.25E-07	0.000603	-0.001532	0.9988
WIND	-9.61E-05	0.060819	-0.001580	0.9987
GAS_PRICE	0.000847	0.095081	0.008907	0.9929
DAY=2	0.006781	1.655649	0.004096	0.9967
DAY=3	0.013145	1.847864	0.007113	0.9943
DAY=4	0.046046	1.880982	0.024480	0.9805
DAY=5	0.042293	1.833083	0.023072	0.9816
DAY=6	0.020870	1.807903	0.011544	0.9908
DAY=7	0.013128	1.804231	0.007276	0.9942

DAY=8	0.010998	1.811616	0.006071	0.9952
DAY=9	0.011041	1.810482	0.006099	0.9951
DAY=10	0.010742	1.805233	0.005950	0.9953
DAY=11	0.010326	1.795244	0.005752	0.9954
DAY=12	0.011089	1.806924	0.006137	0.9951
DAY=13	0.010703	1.806190	0.005926	0.9953
DAY=14	0.010267	1.814663	0.005658	0.9955
DAY=15	0.009945	1.794111	0.005543	0.9956
DAY=16	0.010233	1.801676	0.005680	0.9955
DAY=17	0.010268	1.800405	0.005703	0.9955
DAY=18	0.010398	1.806760	0.005755	0.9954
DAY=19	0.010813	1.814314	0.005960	0.9952
DAY=20	0.010856	1.813286	0.005987	0.9952
DAY=21	0.010340	1.815694	0.005695	0.9955
DAY=22	0.009927	1.801185	0.005511	0.9956
DAY=23	0.010177	1.804645	0.005639	0.9955
DAY=24	0.010083	1.808487	0.005576	0.9956
DAY=25	0.009477	1.806322	0.005246	0.9958
DAY=26	0.009051	1.813318	0.004992	0.9960
DAY=27	0.009292	1.795145	0.005176	0.9959
DAY=28	0.009355	1.781417	0.005251	0.9958
DAY=29	0.010777	1.864499	0.005780	0.9954
DAY=30	0.007511	1.800911	0.004171	0.9967
DAY=31	-0.032922	1.953802	-0.016850	0.9866
MONTH="Aug"	-0.014163	1.383726	-0.010236	0.9918
MONTH="Dec"	-0.017448	1.485517	-0.011745	0.9906
MONTH="Feb"	-0.018679	1.478766	-0.012632	0.9899
MONTH="Jan"	-0.001670	1.500177	-0.001113	0.9991
MONTH="July"	-0.012531	1.395636	-0.008979	0.9928
MONTH="June"	-0.011212	2.578649	-0.004348	0.9965
MONTH="Mar"	-0.011092	1.425502	-0.007781	0.9938
MONTH="May"	-0.013752	1.337483	-0.010282	0.9918
MONTH="Nov"	-0.015997	1.482701	-0.010789	0.9914
MONTH="Oct"	-0.015893	1.432414	-0.011095	0.9912
MONTH="Sept"	-0.019555	1.499008	-0.013046	0.9896
AR(1)	-0.044225	0.347670	-0.127205	0.8989
RESID(-1)	0.045692	0.353142	0.129388	0.8971
RESID(-2)	0.007070	0.086606	0.081632	0.9350

R-squared	0.000055	Mean dependent var	1.83E-09
Adjusted R-squared	-0.155276	S.D. dependent var	3.910646
S.E. of regression	4.203311	Akaike info criterion	5.836173
Sum squared resid	5459.357	Schwarz criterion	6.367308
Log likelihood	-995.6750	Hannan-Quinn criter.	6.047406
F-statistic	0.000353	Durbin-Watson stat	1.966655
Prob(F-statistic)	1.000000		

CENTRAL NORTH

MODEL 1

Dependent Variable: PRICE
Method: Least Squares
Sample: 1 365
Included observations: 365
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	18.22222	3.807517	4.785855	0.0000
LOAD	0.009363	0.000762	12.29313	0.0000
DAY=2	1.891712	5.103507	0.370669	0.7111
DAY=3	-2.705416	3.900124	-0.693675	0.4884
DAY=4	-1.449735	3.820778	-0.379435	0.7046
DAY=5	-2.045560	3.840932	-0.532569	0.5947
DAY=6	-1.196317	3.743459	-0.319575	0.7495
DAY=7	-3.541890	3.784075	-0.935999	0.3500
DAY=8	-4.422420	3.643599	-1.213750	0.2257
DAY=9	-2.770498	3.728400	-0.743080	0.4580
DAY=10	-1.704611	3.767127	-0.452496	0.6512
DAY=11	-1.944104	3.726230	-0.521735	0.6022
DAY=12	-3.234894	3.930044	-0.823119	0.4110
DAY=13	-2.029929	3.900446	-0.520435	0.6031
DAY=14	-2.809955	3.780894	-0.743199	0.4579
DAY=15	-2.119496	3.599175	-0.588884	0.5564
DAY=16	-1.901751	3.618283	-0.525595	0.5995
DAY=17	0.460901	3.796017	0.121417	0.9034
DAY=18	-1.753339	3.585941	-0.488948	0.6252
DAY=19	-1.614726	3.786877	-0.426400	0.6701
DAY=20	-0.513152	3.761421	-0.136425	0.8916
DAY=21	1.662539	3.939328	0.422036	0.6733
DAY=22	1.332802	3.974980	0.335298	0.7376
DAY=23	-0.637483	3.804526	-0.167559	0.8670
DAY=24	0.538562	3.756517	0.143367	0.8861
DAY=25	-1.627495	3.506247	-0.464170	0.6428
DAY=26	1.660708	4.384356	0.378780	0.7051
DAY=27	3.221104	5.366833	0.600187	0.5488
DAY=28	-0.492710	4.287397	-0.114921	0.9086
DAY=29	-2.363817	3.651331	-0.647385	0.5178
DAY=30	-0.172855	3.717731	-0.046495	0.9629
DAY=31	-1.256010	3.942040	-0.318619	0.7502
MONTH="Aug"	16.41798	1.138891	14.41576	0.0000
MONTH="Dec"	13.76012	1.284752	10.71033	0.0000
MONTH="Feb"	3.265460	2.579863	1.265750	0.2065
MONTH="Jan"	-3.036690	1.350505	-2.248560	0.0252
MONTH="July"	6.611640	1.215401	5.439882	0.0000
MONTH="June"	5.295365	1.162232	4.556202	0.0000
MONTH="Mar"	3.390467	1.979883	1.712458	0.0878
MONTH="May"	4.120696	1.356386	3.037995	0.0026
MONTH="Nov"	15.31004	1.361143	11.24793	0.0000
MONTH="Oct"	24.50977	1.300602	18.84495	0.0000
MONTH="Sept"	26.02803	1.449622	17.95504	0.0000

R-squared	0.733058	Mean dependent var	61.06357
Adjusted R-squared	0.698239	S.D. dependent var	11.87164
S.E. of regression	6.521415	Akaike info criterion	6.698330
Sum squared resid	13694.29	Schwarz criterion	7.157770
Log likelihood	-1179.445	Hannan-Quinn criter.	6.880918
F-statistic	21.05368	Durbin-Watson stat	0.869687
Prob(F-statistic)	0.000000	Wald F-statistic	35.84368
Prob(Wald F-statistic)	0.000000		

Dependent Variable: PRICE
Method: ARMA Conditional Least Squares (Gauss-Newton / Marquardt steps)
Date: 03/25/20 Time: 12:28
Sample (adjusted): 2 365
Included observations: 364 after adjustments
Convergence achieved after 7 iterations
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	19.14702	4.003893	4.782100	0.0000
LOAD	0.008832	0.000651	13.56473	0.0000
DAY=2	2.301348	2.895603	0.794773	0.4273
DAY=3	-2.025456	2.742223	-0.738618	0.4607
DAY=4	-0.677011	2.916766	-0.232110	0.8166
DAY=5	-1.127503	2.946461	-0.382663	0.7022
DAY=6	-0.279818	2.987186	-0.093673	0.9254
DAY=7	-2.620909	2.841058	-0.922512	0.3570
DAY=8	-3.521725	2.875392	-1.224781	0.2216
DAY=9	-1.843335	2.900707	-0.635478	0.5256
DAY=10	-0.789679	2.952814	-0.267433	0.7893
DAY=11	-1.032140	3.006947	-0.343252	0.7316
DAY=12	-2.203347	3.287797	-0.670159	0.5032
DAY=13	-1.042762	3.023229	-0.344917	0.7304
DAY=14	-1.899049	2.870412	-0.661595	0.5087
DAY=15	-1.234989	2.825358	-0.437109	0.6623
DAY=16	-0.960441	2.749602	-0.349302	0.7271
DAY=17	1.388188	3.019842	0.459689	0.6461
DAY=18	-0.803771	2.910918	-0.276123	0.7826
DAY=19	-0.547294	2.947598	-0.185675	0.8528
DAY=20	0.492985	2.875751	0.171428	0.8640
DAY=21	2.580467	3.187809	0.809480	0.4188
DAY=22	2.226597	3.435256	0.648160	0.5173
DAY=23	0.247276	3.232698	0.076492	0.9391
DAY=24	1.305702	3.016346	0.432875	0.6654
DAY=25	-1.019609	2.883954	-0.353546	0.7239
DAY=26	2.255102	3.606773	0.625241	0.5323
DAY=27	3.563145	3.820495	0.932640	0.3517
DAY=28	-0.596829	3.357959	-0.177736	0.8590
DAY=29	-0.704637	2.730214	-0.258088	0.7965
DAY=30	1.464335	2.282662	0.641503	0.5217
DAY=31	1.291571	2.448447	0.527506	0.5982
MONTH="Aug"	16.77193	2.575181	6.512911	0.0000
MONTH="Dec"	14.44077	2.942798	4.907155	0.0000
MONTH="Feb"	2.190703	4.407539	0.497035	0.6195
MONTH="Jan"	-2.723302	3.300366	-0.825152	0.4099
MONTH="July"	7.854879	2.621882	2.995893	0.0030
MONTH="June"	4.901541	2.553620	1.919448	0.0558
MONTH="Mar"	4.465632	3.624550	1.232051	0.2188
MONTH="May"	4.010504	2.666417	1.504080	0.1335
MONTH="Nov"	15.30560	2.725967	5.614742	0.0000
MONTH="Oct"	24.39323	2.641530	9.234506	0.0000
MONTH="Sept"	25.10801	3.070955	8.175963	0.0000
AR(1)	0.581680	0.093026	6.252861	0.0000

R-squared	0.820227	Mean dependent var	61.10682
Adjusted R-squared	0.796070	S.D. dependent var	11.85915
S.E. of regression	5.355431	Akaike info criterion	6.307025
Sum squared resid	9177.804	Schwarz criterion	6.778109
Log likelihood	-1103.878	Hannan-Quinn criter.	6.494259
F-statistic	33.95395	Durbin-Watson stat	2.148898
Prob(F-statistic)	0.000000		

Inverted AR Roots	.58

MODEL 2

Dependent Variable: PRICE
Method: Least Squares
Sample: 1 365
Included observations: 365
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	20.18809	4.645064	4.346138	0.0000
LOAD	0.009306	0.000771	12.06955	0.0000
RES	-0.004124	0.003818	-1.080024	0.2809
DAY=2	2.143976	5.056266	0.424024	0.6718
DAY=3	-2.526573	3.831423	-0.659435	0.5101
DAY=4	-1.217832	3.720218	-0.327355	0.7436
DAY=5	-1.733328	3.728797	-0.464849	0.6424
DAY=6	-1.045143	3.655467	-0.285912	0.7751
DAY=7	-3.228941	3.706404	-0.871179	0.3843
DAY=8	-3.917990	3.518812	-1.113441	0.2664
DAY=9	-2.354748	3.603349	-0.653489	0.5139
DAY=10	-1.060726	3.650976	-0.290532	0.7716
DAY=11	-1.597913	3.601704	-0.443655	0.6576
DAY=12	-2.869366	3.850574	-0.745179	0.4567
DAY=13	-1.513253	3.769797	-0.401415	0.6884
DAY=14	-2.305461	3.647231	-0.632113	0.5278
DAY=15	-1.592830	3.475041	-0.458363	0.6470
DAY=16	-1.604226	3.533810	-0.453965	0.6502
DAY=17	0.714201	3.708447	0.192588	0.8474
DAY=18	-1.201265	3.488867	-0.344314	0.7308
DAY=19	-1.155122	3.686901	-0.313304	0.7543
DAY=20	0.040293	3.631385	0.011096	0.9912
DAY=21	2.235955	3.832463	0.583425	0.5600
DAY=22	1.707494	3.918460	0.435756	0.6633
DAY=23	-0.073430	3.664532	-0.020038	0.9840
DAY=24	1.031275	3.649818	0.282555	0.7777
DAY=25	-1.058910	3.388350	-0.312515	0.7549
DAY=26	2.426406	4.225370	0.574247	0.5662
DAY=27	4.044913	5.046593	0.801514	0.4234
DAY=28	0.102479	4.185384	0.024485	0.9805
DAY=29	-1.822874	3.505524	-0.520000	0.6034
DAY=30	0.265510	3.603721	0.073676	0.9413
DAY=31	-1.005212	3.876485	-0.259310	0.7956
MONTH="Aug"	16.77302	1.168316	14.35657	0.0000
MONTH="Dec"	12.85006	1.446202	8.885386	0.0000
MONTH="Feb"	2.690232	2.911387	0.924038	0.3562
MONTH="Jan"	-3.846998	1.444858	-2.662544	0.0081
MONTH="July"	7.112835	1.333217	5.335091	0.0000
MONTH="June"	5.604518	1.188399	4.716022	0.0000
MONTH="Mar"	2.968740	1.901290	1.561434	0.1194
MONTH="May"	3.907255	1.345122	2.904759	0.0039
MONTH="Nov"	14.55863	1.444820	10.07644	0.0000
MONTH="Oct"	24.30419	1.270443	19.13049	0.0000
MONTH="Sept"	26.35348	1.479652	17.81060	0.0000

R-squared	0.734891	Mean dependent var	61.06357
Adjusted R-squared	0.699378	S.D. dependent var	11.87164
S.E. of regression	6.509106	Akaike info criterion	6.696921
Sum squared resid	13600.27	Schwarz criterion	7.167045
Log likelihood	-1178.188	Hannan-Quinn criter.	6.883754
F-statistic	20.69351	Durbin-Watson stat	0.859082
Prob(F-statistic)	0.000000	Wald F-statistic	36.29908
Prob(Wald F-statistic)	0.000000		

Dependent Variable: PRICE
Method: ARMA Conditional Least Squares (Gauss-Newton / Marquardt steps)
Sample (adjusted): 2 365
Included observations: 364 after adjustments
Convergence achieved after 8 iterations
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	21.89166	4.498793	4.866118	0.0000
LOAD	0.008715	0.000680	12.82425	0.0000
RES	-0.005182	0.002893	-1.791325	0.0742
DAY=2	2.624680	2.841162	0.923805	0.3563
DAY=3	-1.785912	2.740878	-0.651584	0.5151
DAY=4	-0.370015	2.884122	-0.128294	0.8980
DAY=5	-0.710776	2.889221	-0.246009	0.8058
DAY=6	-0.067097	2.879918	-0.023298	0.9814
DAY=7	-2.205165	2.762023	-0.798388	0.4252
DAY=8	-2.867287	2.810902	-1.020059	0.3085
DAY=9	-1.298158	2.800664	-0.463518	0.6433
DAY=10	0.041161	2.899737	0.014195	0.9887
DAY=11	-0.575561	2.918138	-0.197236	0.8438
DAY=12	-1.712460	3.209941	-0.533486	0.5941
DAY=13	-0.365619	2.946183	-0.124099	0.9013
DAY=14	-1.243541	2.791615	-0.445456	0.6563
DAY=15	-0.553797	2.740109	-0.202108	0.8400
DAY=16	-0.562406	2.683641	-0.209568	0.8341
DAY=17	1.729534	2.978896	0.580596	0.5619
DAY=18	-0.085053	2.864721	-0.029690	0.9763
DAY=19	0.065256	2.898913	0.022510	0.9821
DAY=20	1.218739	2.840709	0.429026	0.6682
DAY=21	3.324757	3.113912	1.067711	0.2865
DAY=22	2.720721	3.408863	0.798132	0.4254
DAY=23	0.981550	3.188081	0.307881	0.7584
DAY=24	1.946162	2.981096	0.652834	0.5143
DAY=25	-0.286506	2.839931	-0.100885	0.9197
DAY=26	3.254477	3.434910	0.947471	0.3441
DAY=27	4.651013	3.610683	1.288126	0.1986
DAY=28	0.233785	3.140966	0.074431	0.9407
DAY=29	0.077120	2.591872	0.029755	0.9763
DAY=30	2.059100	2.217020	0.928769	0.3537
DAY=31	1.633952	2.378976	0.686830	0.4927
MONTH="Aug"	17.11494	2.538270	6.742758	0.0000
MONTH="Dec"	13.24234	2.967778	4.462039	0.0000
MONTH="Feb"	1.479279	4.626754	0.319723	0.7494
MONTH="Jan"	-3.809684	3.369163	-1.130751	0.2590
MONTH="July"	8.387672	2.628765	3.190727	0.0016
MONTH="June"	5.079536	2.535112	2.003673	0.0460
MONTH="Mar"	3.639770	3.516544	1.035042	0.3014
MONTH="May"	3.485616	2.716552	1.283103	0.2004
MONTH="Nov"	14.16244	2.789985	5.076169	0.0000
MONTH="Oct"	23.97844	2.635003	9.099966	0.0000
MONTH="Sept"	25.31690	3.054112	8.289448	0.0000
AR(1)	0.588072	0.097084	6.057376	0.0000

R-squared	0.823161	Mean dependent var	61.10682
Adjusted R-squared	0.798770	S.D. dependent var	11.85915
S.E. of regression	5.319859	Akaike info criterion	6.296061
Sum squared resid	9027.988	Schwarz criterion	6.777852
Log likelihood	-1100.883	Hannan-Quinn criter.	6.487551
F-statistic	33.74782	Durbin-Watson stat	2.135308
Prob(F-statistic)	0.000000		

Inverted AR Roots	.59

MODEL 3

Dependent Variable: PRICE
Method: Least Squares
Sample: 1 365
Included observations: 365
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	20.69207	4.745050	4.360770	0.0000
LOAD	0.009350	0.000767	12.19803	0.0000
WIND	-0.023875	0.022472	-1.062419	0.2888
SOLAR	-0.004319	0.003889	-1.110580	0.2676
DAY=2	2.181869	5.058367	0.431339	0.6665
DAY=3	-2.378066	3.823751	-0.621920	0.5344
DAY=4	-1.136952	3.717226	-0.305860	0.7599
DAY=5	-1.834546	3.689112	-0.497287	0.6193
DAY=6	-1.248552	3.637932	-0.343204	0.7317
DAY=7	-3.417981	3.680884	-0.928576	0.3538
DAY=8	-4.064468	3.468813	-1.171717	0.2422
DAY=9	-2.501218	3.565798	-0.701447	0.4835
DAY=10	-1.223372	3.601632	-0.339672	0.7343
DAY=11	-1.743483	3.562268	-0.489430	0.6249
DAY=12	-2.957187	3.807574	-0.776659	0.4379
DAY=13	-1.538838	3.739428	-0.411517	0.6810
DAY=14	-2.430664	3.627411	-0.670082	0.5033
DAY=15	-1.530424	3.469931	-0.441053	0.6595
DAY=16	-1.611413	3.515660	-0.458353	0.6470
DAY=17	0.668382	3.681377	0.181558	0.8560
DAY=18	-1.157997	3.473123	-0.333417	0.7390
DAY=19	-1.201904	3.651826	-0.329124	0.7423
DAY=20	0.051476	3.614645	0.014241	0.9886
DAY=21	2.327822	3.808500	0.611217	0.5415
DAY=22	1.842493	3.921619	0.469830	0.6388
DAY=23	0.000589	3.660248	0.000161	0.9999
DAY=24	1.013668	3.649274	0.277772	0.7814
DAY=25	-1.056011	3.374995	-0.312893	0.7546
DAY=26	2.488092	4.222285	0.589276	0.5561
DAY=27	3.995148	5.040373	0.792629	0.4286
DAY=28	0.034804	4.146336	0.008394	0.9933
DAY=29	-1.856879	3.462108	-0.536344	0.5921
DAY=30	0.225344	3.583429	0.062885	0.9499
DAY=31	-1.012553	3.820296	-0.265046	0.7911
MONTH="Aug"	16.60537	1.152595	14.40695	0.0000
MONTH="Dec"	12.92264	1.425741	9.063811	0.0000
MONTH="Feb"	2.860553	2.896465	0.987601	0.3241
MONTH="Jan"	-3.806934	1.452538	-2.620885	0.0092
MONTH="July"	6.826423	1.292918	5.279857	0.0000
MONTH="June"	5.434294	1.160564	4.682460	0.0000
MONTH="Mar"	3.239703	1.848071	1.753019	0.0806
MONTH="May"	3.669153	1.368946	2.680276	0.0077
MONTH="Nov"	14.64066	1.437273	10.18642	0.0000
MONTH="Oct"	24.44869	1.258473	19.42726	0.0000
MONTH="Sept"	26.12995	1.444557	18.08856	0.0000

R-squared	0.735684	Mean dependent var	61.06357
Adjusted R-squared	0.699340	S.D. dependent var	11.87164
S.E. of regression	6.509508	Akaike info criterion	6.699404
Sum squared resid	13559.58	Schwarz criterion	7.180213
Log likelihood	-1177.641	Hannan-Quinn criter.	6.890484
F-statistic	20.24254	Durbin-Watson stat	0.852327
Prob(F-statistic)	0.000000	Wald F-statistic	35.94387
Prob(Wald F-statistic)	0.000000		

Dependent Variable: PRICE
Method: ARMA Conditional Least Squares (Gauss-Newton / Marquardt steps)
Sample (adjusted): 2 365
Included observations: 364 after adjustments
Convergence achieved after 8 iterations
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	22.77780	4.584498	4.968439	0.0000
LOAD	0.008812	0.000681	12.94142	0.0000
WIND	-0.040347	0.020013	-2.015996	0.0446
SOLAR	-0.005646	0.002963	-1.905811	0.0576
DAY=2	2.707215	2.824826	0.958365	0.3386
DAY=3	-1.503559	2.738772	-0.548990	0.5834
DAY=4	-0.199309	2.889549	-0.068976	0.9451
DAY=5	-0.859471	2.873337	-0.299120	0.7650
DAY=6	-0.397343	2.870326	-0.138431	0.8900
DAY=7	-2.502673	2.745044	-0.911706	0.3626
DAY=8	-3.081296	2.748169	-1.121218	0.2630
DAY=9	-1.514507	2.766121	-0.547520	0.5844
DAY=10	-0.196230	2.878160	-0.068179	0.9457
DAY=11	-0.790597	2.893749	-0.273209	0.7849
DAY=12	-1.828506	3.155757	-0.579419	0.5627
DAY=13	-0.365162	2.897547	-0.126025	0.8998
DAY=14	-1.417384	2.762808	-0.513023	0.6083
DAY=15	-0.393136	2.729245	-0.144046	0.8856
DAY=16	-0.533867	2.656872	-0.200938	0.8409
DAY=17	1.688649	2.943075	0.573770	0.5665
DAY=18	0.039665	2.845433	0.013940	0.9889
DAY=19	0.022968	2.862304	0.008024	0.9936
DAY=20	1.283677	2.813311	0.456287	0.6485
DAY=21	3.535823	3.065157	1.153554	0.2495
DAY=22	3.002334	3.433101	0.874526	0.3825
DAY=23	1.158933	3.195356	0.362693	0.7171
DAY=24	1.960631	2.974012	0.659255	0.5102
DAY=25	-0.231281	2.856614	-0.080963	0.9355
DAY=26	3.415414	3.391502	1.007051	0.3147
DAY=27	4.619064	3.561300	1.297016	0.1956
DAY=28	0.173261	3.085864	0.056147	0.9553
DAY=29	0.102426	2.556226	0.040069	0.9681
DAY=30	2.070884	2.200231	0.941212	0.3473
DAY=31	1.622464	2.340229	0.693293	0.4886
MONTH="Aug"	16.80461	2.580280	6.512706	0.0000
MONTH="Dec"	13.33236	2.939479	4.535618	0.0000
MONTH="Feb"	1.816831	4.618377	0.393392	0.6943
MONTH="Jan"	-3.871063	3.348423	-1.156085	0.2485
MONTH="July"	7.956160	2.663073	2.987586	0.0030
MONTH="June"	4.694905	2.534458	1.852430	0.0649
MONTH="Mar"	4.094880	3.481584	1.176154	0.2404
MONTH="May"	2.953216	2.768412	1.066755	0.2869
MONTH="Nov"	14.17117	2.752190	5.149055	0.0000
MONTH="Oct"	24.17599	2.590625	9.332104	0.0000
MONTH="Sept"	24.86773	3.081071	8.071132	0.0000
AR(1)	0.593986	0.098730	6.016269	0.0000

R-squared	0.825104	Mean dependent var	61.10682
Adjusted R-squared	0.800354	S.D. dependent var	11.85915
S.E. of regression	5.298874	Akaike info criterion	6.290511
Sum squared resid	8928.826	Schwarz criterion	6.783008
Log likelihood	-1098.873	Hannan-Quinn criter.	6.486256
F-statistic	33.33822	Durbin-Watson stat	2.147387
Prob(F-statistic)	0.000000		

Inverted AR Roots	.59

<u>MODEL 4</u>

Dependent Variable: PRICE
Method: Least Squares
Sample: 1 365
Included observations: 362
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-8.779490	4.452162	-1.971961	0.0495
LOAD	0.006582	0.000456	14.44049	0.0000
WIND	-0.064595	0.014222	-4.542021	0.0000
SOLAR	-0.008102	0.001930	-4.197721	0.0000
GAS_PRICE	1.784382	0.176677	10.09971	0.0000
DAY=2	2.111224	2.322679	0.908961	0.3641
DAY=3	0.036345	1.661973	0.021868	0.9826
DAY=4	2.671215	2.101093	1.271345	0.2045
DAY=5	0.726995	1.543031	0.471147	0.6379
DAY=6	2.321394	1.641521	1.414173	0.1583
DAY=7	0.535510	1.722784	0.310840	0.7561
DAY=8	-0.209501	1.563214	-0.134019	0.8935
DAY=9	1.470306	1.622345	0.906285	0.3655
DAY=10	2.522666	1.798655	1.402529	0.1617
DAY=11	1.579903	1.714944	0.921256	0.3576
DAY=12	0.990176	1.730121	0.572316	0.5675
DAY=13	2.058180	1.948699	1.056182	0.2917
DAY=14	0.375362	1.824340	0.205752	0.8371
DAY=15	1.600537	1.586079	1.009116	0.3137
DAY=16	1.275832	1.626553	0.784377	0.4334
DAY=17	3.420169	1.937690	1.765075	0.0785
DAY=18	2.125675	1.581804	1.343829	0.1800
DAY=19	1.951716	1.661909	1.174382	0.2411
DAY=20	3.338745	1.743147	1.915354	0.0563
DAY=21	5.149524	2.040308	2.523896	0.0121
DAY=22	4.173955	2.417002	1.726915	0.0852
DAY=23	2.622870	1.817692	1.442967	0.1500
DAY=24	3.563071	1.855358	1.920422	0.0557
DAY=25	0.922139	1.660288	0.555409	0.5790
DAY=26	2.597765	1.840997	1.411064	0.1592
DAY=27	5.065658	2.194117	2.308746	0.0216
DAY=28	1.404335	1.859780	0.755108	0.4507
DAY=29	1.550846	1.667222	0.930198	0.3530
DAY=30	3.408334	1.914182	1.780570	0.0759
DAY=31	2.448403	1.746512	1.401881	0.1619
MONTH="Aug"	10.82999	1.159441	9.340698	0.0000
MONTH="Dec"	6.936666	1.261754	5.497636	0.0000
MONTH="Feb"	2.746083	1.382657	1.986091	0.0479
MONTH="Jan"	0.170579	1.271007	0.134207	0.8933
MONTH="July"	4.382971	1.164540	3.763693	0.0002
MONTH="June"	2.934615	1.066527	2.751562	0.0063
MONTH="Mar"	2.154660	1.085044	1.985781	0.0479
MONTH="May"	0.628989	1.237807	0.508148	0.6117
MONTH="Nov"	9.615500	1.299899	7.397111	0.0000
MONTH="Oct"	15.75292	1.362331	11.56321	0.0000
MONTH="Sept"	13.90460	1.744870	7.968846	0.0000

R-squared	0.893896	Mean dependent var	61.17761
Adjusted R-squared	0.878787	S.D. dependent var	11.84360
S.E. of regression	4.123434	Akaike info criterion	5.789491
Sum squared resid	5372.856	Schwarz criterion	6.284010
Log likelihood	-1001.898	Hannan-Quinn criter.	5.986081
F-statistic	59.16041	Durbin-Watson stat	1.657490
Prob(F-statistic)	0.000000	Wald F-statistic	61.51888
Prob(Wald F-statistic)	0.000000		

Dependent Variable: PRICE
Method: ARMA Conditional Least Squares (Gauss-Newton / Marquardt steps)
Sample (adjusted): 4 365
Included observations: 358 after adjustments
Convergence achieved after 5 iterations
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-8.655460	4.769751	-1.814657	0.0705
LOAD	0.006648	0.000502	13.24698	0.0000
WIND	-0.064743	0.014879	-4.351371	0.0000
SOLAR	-0.007684	0.001912	-4.017984	0.0001
GAS_PRICE	1.738622	0.191094	9.098276	0.0000
DAY=2	2.422126	2.197224	1.102357	0.2712
DAY=3	-0.067021	1.646774	-0.040698	0.9676
DAY=4	2.114124	2.141298	0.987310	0.3243
DAY=5	0.804636	1.556459	0.516966	0.6055
DAY=6	2.476079	1.641828	1.508123	0.1325
DAY=7	0.683485	1.680478	0.406721	0.6845
DAY=8	-0.069695	1.588436	-0.043876	0.9650
DAY=9	1.615248	1.645048	0.981885	0.3269
DAY=10	2.653152	1.816419	1.460650	0.1451
DAY=11	1.746726	1.776545	0.983215	0.3263
DAY=12	1.146913	1.794908	0.638981	0.5233
DAY=13	2.215223	1.894578	1.169244	0.2432
DAY=14	0.544018	1.749959	0.310875	0.7561
DAY=15	1.772895	1.591552	1.113941	0.2662
DAY=16	1.469227	1.604919	0.915453	0.3607
DAY=17	3.617326	1.954130	1.851119	0.0651
DAY=18	2.292308	1.598321	1.434198	0.1525
DAY=19	2.125361	1.648168	1.289530	0.1982
DAY=20	3.504359	1.747911	2.004884	0.0458
DAY=21	5.329674	2.041715	2.610391	0.0095
DAY=22	4.386038	2.412898	1.817747	0.0701
DAY=23	2.807797	1.744528	1.609488	0.1085
DAY=24	3.746817	1.834500	2.042419	0.0420
DAY=25	1.113950	1.693653	0.657721	0.5112
DAY=26	2.829150	1.782448	1.587227	0.1135
DAY=27	5.258297	2.301963	2.284266	0.0230
DAY=28	1.602617	1.821840	0.879669	0.3797
DAY=29	1.829275	1.631224	1.121413	0.2630
DAY=30	3.977466	1.859303	2.139224	0.0332
DAY=31	2.619102	1.722723	1.520327	0.1294
MONTH="Aug"	11.23438	1.309821	8.577033	0.0000
MONTH="Dec"	7.534350	1.432153	5.260856	0.0000
MONTH="Feb"	3.140443	1.642612	1.911859	0.0568
MONTH="Jan"	0.342164	1.465240	0.233521	0.8155
MONTH="July"	4.751600	1.324372	3.587814	0.0004
MONTH="June"	3.197890	1.218646	2.624133	0.0091
MONTH="Mar"	2.549364	1.245275	2.047230	0.0415
MONTH="May"	0.992067	1.427487	0.694975	0.4876
MONTH="Nov"	10.04978	1.455474	6.904812	0.0000
MONTH="Oct"	16.30181	1.513397	10.77167	0.0000
MONTH="Sept"	14.45223	1.901102	7.602026	0.0000
AR(1)	0.158790	0.066743	2.379122	0.0180

R-squared	0.897850	Mean dependent var	61.29230
Adjusted R-squared	0.882741	S.D. dependent var	11.84535
S.E. of regression	4.056210	Akaike info criterion	5.760205
Sum squared resid	5116.832	Schwarz criterion	6.269660
Log likelihood	-984.0766	Hannan-Quinn criter.	5.962816
F-statistic	59.42504	Durbin-Watson stat	1.954687
Prob(F-statistic)	0.000000		

TEST ON THE RESIDUALS

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.062895	Prob. F(2,309)	0.9391
Obs*R-squared	0.145677	Prob. Chi-Square(2)	0.9298

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 03/25/20 Time: 12:33
Sample: 4 365
Included observations: 358
Coefficient covariance computed using outer product of gradients
Presample and interior missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.008257	2.769080	-0.002982	0.9976
LOAD	-6.23E-06	0.000504	-0.012362	0.9901
WIND	-2.25E-05	0.013867	-0.001621	0.9987
SOLAR	-7.62E-05	0.001862	-0.040926	0.9674
GAS_PRICE	0.004638	0.092368	0.050214	0.9600
DAY=2	-0.026814	1.617511	-0.016577	0.9868
DAY=3	0.012450	1.788199	0.006963	0.9944
DAY=4	0.013831	1.791941	0.007718	0.9938
DAY=5	0.048022	1.779387	0.026988	0.9785
DAY=6	0.011656	1.747746	0.006669	0.9947
DAY=7	0.002553	1.745632	0.001463	0.9988
DAY=8	0.002160	1.748196	0.001236	0.9990
DAY=9	0.000259	1.745478	0.000149	0.9999
DAY=10	0.003487	1.756621	0.001985	0.9984
DAY=11	-0.002642	1.738587	-0.001520	0.9988
DAY=12	-0.001648	1.748661	-0.000943	0.9992
DAY=13	-0.000359	1.748380	-0.000205	0.9998
DAY=14	-0.001530	1.742293	-0.000878	0.9993
DAY=15	-0.001645	1.741292	-0.000945	0.9992
DAY=16	-0.005758	1.733262	-0.003322	0.9974
DAY=17	-0.006487	1.731409	-0.003746	0.9970
DAY=18	-0.000973	1.746335	-0.000557	0.9996
DAY=19	-0.002654	1.752462	-0.001514	0.9988
DAY=20	-0.000970	1.751412	-0.000554	0.9996
DAY=21	-0.002137	1.745651	-0.001224	0.9990
DAY=22	-0.006977	1.735298	-0.004021	0.9968
DAY=23	-0.002719	1.744744	-0.001558	0.9988
DAY=24	-0.003088	1.737183	-0.001777	0.9986
DAY=25	-0.003166	1.738776	-0.001821	0.9985
DAY=26	-0.005828	1.753774	-0.003323	0.9974
DAY=27	-0.001840	1.757008	-0.001047	0.9992
DAY=28	-0.006794	1.728934	-0.003930	0.9969
DAY=29	-0.031230	1.809888	-0.017255	0.9862
DAY=30	-0.020983	1.745974	-0.012018	0.9904
DAY=31	-0.046603	1.903527	-0.024482	0.9805
MONTH="Aug"	-0.032123	1.311708	-0.024490	0.9805
MONTH="Dec"	-0.073554	1.388037	-0.052992	0.9578
MONTH="Feb"	-0.066863	1.370592	-0.048784	0.9611
MONTH="Jan"	-0.034284	1.407273	-0.024362	0.9806
MONTH="July"	-0.033946	1.348591	-0.025172	0.9799
MONTH="June"	-0.030685	1.307181	-0.023475	0.9813
MONTH="Mar"	-0.027276	1.329943	-0.020509	0.9837
MONTH="May"	-0.041329	1.286691	-0.032120	0.9744
MONTH="Nov"	-0.052652	1.364632	-0.038583	0.9692
MONTH="Oct"	-0.059786	1.364714	-0.043808	0.9651
MONTH="Sept"	-0.055130	1.438197	-0.038333	0.9694
AR(1)	-0.068966	0.382480	-0.180312	0.8570

RESID(-1)	0.073870	0.387890	0.190441	0.8491
RESID(-2)	-0.006986	0.087194	-0.080116	0.9362

R-squared	0.000407	Mean dependent var	4.94E-09
Adjusted R-squared	-0.154870	S.D. dependent var	3.785877
S.E. of regression	4.068487	Akaike info criterion	5.770971
Sum squared resid	5114.750	Schwarz criterion	6.302105
Log likelihood	-984.0038	Hannan-Quinn criter.	5.982204
F-statistic	0.002621	Durbin-Watson stat	1.961790
Prob(F-statistic)	1.000000		

CENTRAL SOUTH

MODEL 1

Dependent Variable: PRICE
Method: Least Squares
Sample: 1 365
Included observations: 365
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	16.13053	5.317372	3.033553	0.0026
LOAD	0.007496	0.000864	8.679216	0.0000
DAY=2	2.472117	5.221624	0.473438	0.6362
DAY=3	-1.005917	4.454011	-0.225845	0.8215
DAY=4	-0.401834	4.347358	-0.092432	0.9264
DAY=5	-0.908697	4.335411	-0.209599	0.8341
DAY=6	-1.563240	4.297933	-0.363719	0.7163
DAY=7	-1.959735	4.347135	-0.450811	0.6524
DAY=8	-3.854116	4.093229	-0.941583	0.3471
DAY=9	-2.339494	4.236365	-0.552241	0.5812
DAY=10	-1.509295	4.330982	-0.348488	0.7277
DAY=11	-1.165865	4.298626	-0.271218	0.7864
DAY=12	-1.862814	4.376617	-0.425629	0.6707
DAY=13	-2.447019	4.262756	-0.574046	0.5663
DAY=14	-2.206039	4.211349	-0.523832	0.6008
DAY=15	-1.435091	4.133641	-0.347174	0.7287
DAY=16	-1.530433	4.169905	-0.367019	0.7138
DAY=17	-1.111028	4.171622	-0.266330	0.7902
DAY=18	-2.042203	4.067051	-0.502134	0.6159
DAY=19	-0.031403	4.227323	-0.007429	0.9941
DAY=20	0.339596	4.244920	0.080000	0.9363
DAY=21	2.249515	4.360911	0.515836	0.6063
DAY=22	1.360098	4.307207	0.315773	0.7524
DAY=23	0.494799	4.318585	0.114574	0.9089
DAY=24	1.525282	4.246205	0.359211	0.7197
DAY=25	-1.551565	4.052245	-0.382890	0.7021
DAY=26	2.779014	4.792430	0.579876	0.5624
DAY=27	2.895062	5.766788	0.502023	0.6160
DAY=28	0.490221	4.725118	0.103748	0.9174
DAY=29	-1.799625	4.078986	-0.441194	0.6594
DAY=30	0.112837	4.129147	0.027327	0.9782
DAY=31	-2.073099	4.818498	-0.430238	0.6673
MONTH="Aug"	14.34079	1.369878	10.46866	0.0000
MONTH="Dec"	10.20643	1.479663	6.897812	0.0000
MONTH="Feb"	-0.693524	2.552597	-0.271694	0.7860
MONTH="Jan"	-6.955656	1.453494	-4.785472	0.0000
MONTH="July"	5.128133	1.439109	3.563407	0.0004
MONTH="June"	6.715378	1.517732	4.424615	0.0000
MONTH="Mar"	0.386249	2.004490	0.192692	0.8473
MONTH="May"	3.259884	1.467864	2.220836	0.0271

MONTH="Nov"	12.67734	1.534308	8.262579	0.0000
MONTH="Oct"	19.16678	1.364572	14.04600	0.0000
MONTH="Sept"	22.79371	1.548617	14.71875	0.0000

R-squared	0.666971	Mean dependent var	60.93992
Adjusted R-squared	0.623532	S.D. dependent var	11.02542
S.E. of regression	6.764863	Akaike info criterion	6.771632
Sum squared resid	14735.81	Schwarz criterion	7.231072
Log likelihood	-1192.823	Hannan-Quinn criter.	6.954219
F-statistic	15.35434	Durbin-Watson stat	0.834663
Prob(F-statistic)	0.000000	Wald F-statistic	26.23368
Prob(Wald F-statistic)	0.000000		

Dependent Variable: PRICE
Method: ARMA Conditional Least Squares (Gauss-Newton / Marquardt steps)
Sample (adjusted): 2 365
Included observations: 364 after adjustments
Convergence achieved after 9 iterations
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	15.32840	5.751646	2.665046	0.0081
LOAD	0.007476	0.000713	10.47975	0.0000
DAY=2	2.671037	2.910263	0.917799	0.3594
DAY=3	-0.685039	2.699628	-0.253753	0.7998
DAY=4	-0.008407	3.017989	-0.002786	0.9978
DAY=5	-0.468636	3.277467	-0.142987	0.8864
DAY=6	-1.095868	3.443123	-0.318277	0.7505
DAY=7	-1.477713	3.294093	-0.448595	0.6540
DAY=8	-3.364362	3.176898	-1.059008	0.2904
DAY=9	-1.842709	3.207360	-0.574525	0.5660
DAY=10	-1.007420	3.330296	-0.302502	0.7625
DAY=11	-0.663731	3.402585	-0.195067	0.8455
DAY=12	-1.355290	3.408417	-0.397630	0.6912
DAY=13	-1.940338	3.255892	-0.595947	0.5516
DAY=14	-1.701827	3.150510	-0.540175	0.5895
DAY=15	-0.933027	3.186369	-0.292818	0.7699
DAY=16	-1.027571	3.156045	-0.325588	0.7449
DAY=17	-0.608997	3.190154	-0.190899	0.8487
DAY=18	-1.543398	3.142718	-0.491103	0.6237
DAY=19	0.465824	3.199529	0.145592	0.8843
DAY=20	0.828622	3.135479	0.264273	0.7917
DAY=21	2.723698	3.497984	0.778648	0.4368
DAY=22	1.813530	3.552371	0.510513	0.6100
DAY=23	0.913593	3.500789	0.260968	0.7943
DAY=24	1.883995	3.412425	0.552099	0.5813
DAY=25	-1.290052	3.276077	-0.393780	0.6940
DAY=26	2.890354	3.909094	0.739392	0.4602
DAY=27	2.753433	4.037390	0.681984	0.4957
DAY=28	-0.070566	3.561917	-0.019811	0.9842
DAY=29	-0.624981	3.006711	-0.207862	0.8355
DAY=30	1.209242	2.653633	0.455693	0.6489
DAY=31	0.502722	2.997960	0.167688	0.8669
MONTH="Aug"	15.13099	3.469015	4.361754	0.0000
MONTH="Dec"	10.89500	3.744013	2.909979	0.0039
MONTH="Feb"	-1.917712	4.949242	-0.387476	0.6987
MONTH="Jan"	-5.716975	3.895640	-1.467532	0.1432
MONTH="July"	7.195411	3.816127	1.885527	0.0603
MONTH="June"	5.742298	3.577006	1.605337	0.1094
MONTH="Mar"	2.218031	4.664396	0.475524	0.6347
MONTH="May"	3.528238	3.395090	1.039218	0.2995
MONTH="Nov"	12.92587	3.578278	3.612316	0.0004
MONTH="Oct"	19.51675	3.354679	5.817770	0.0000

MONTH="Sept"	22.26560	3.787972	5.877975	0.0000
AR(1)	0.607520	0.084500	7.189617	0.0000

R-squared	0.782416	Mean dependent var	60.98315
Adjusted R-squared	0.753178	S.D. dependent var	11.00958
S.E. of regression	5.469687	Akaike info criterion	6.349245
Sum squared resid	9573.591	Schwarz criterion	6.820330
Log likelihood	-1111.563	Hannan-Quinn criter.	6.536480
F-statistic	26.76037	Durbin-Watson stat	2.116508
Prob(F-statistic)	0.000000		

Inverted AR Roots	.61

MODEL 2

Dependent Variable: PRICE
Method: Least Squares
Sample: 1 365
Included observations: 365
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	24.35576	5.188504	4.694177	0.0000
LOAD	0.007307	0.000801	9.124496	0.0000
RES	-0.007681	0.001275	-6.022950	0.0000
DAY=2	3.315931	4.813752	0.688845	0.4914
DAY=3	-0.134173	3.876504	-0.034612	0.9724
DAY=4	-0.865731	3.813190	-0.227036	0.8205
DAY=5	-1.214753	3.756634	-0.323362	0.7466
DAY=6	-1.893789	3.851027	-0.491762	0.6232
DAY=7	-1.882916	3.843024	-0.489957	0.6245
DAY=8	-3.594182	3.562707	-1.008835	0.3138
DAY=9	-2.315890	3.703858	-0.625264	0.5322
DAY=10	-1.251938	3.772397	-0.331868	0.7402
DAY=11	-1.919762	3.788743	-0.506702	0.6127
DAY=12	-1.469635	3.776661	-0.389136	0.6974
DAY=13	-1.665734	3.600406	-0.462652	0.6439
DAY=14	-2.537865	3.577393	-0.709417	0.4786
DAY=15	-0.882453	3.530636	-0.249942	0.8028
DAY=16	-0.952337	3.662078	-0.260054	0.7950
DAY=17	-1.236060	3.686465	-0.335297	0.7376
DAY=18	-0.800672	3.570680	-0.224235	0.8227
DAY=19	0.266162	3.689447	0.072141	0.9425
DAY=20	0.322397	3.794687	0.084960	0.9323
DAY=21	2.406736	3.771175	0.638193	0.5238
DAY=22	1.668386	3.843032	0.434133	0.6645
DAY=23	1.322891	3.628172	0.364616	0.7156
DAY=24	2.320193	3.668684	0.632432	0.5276
DAY=25	0.202073	3.470264	0.058230	0.9536
DAY=26	5.008906	4.409485	1.135939	0.2568
DAY=27	4.355896	5.515782	0.789715	0.4303
DAY=28	1.131084	4.119618	0.274560	0.7838
DAY=29	-0.982012	3.482913	-0.281951	0.7782
DAY=30	0.364447	3.559375	0.102391	0.9185
DAY=31	-1.089096	4.227042	-0.257650	0.7968
MONTH="Aug"	14.35679	1.299723	11.04604	0.0000
MONTH="Dec"	9.213623	1.248325	7.380790	0.0000
MONTH="Feb"	-1.571189	2.447092	-0.642064	0.5213
MONTH="Jan"	-7.704113	1.308845	-5.886194	0.0000
MONTH="July"	5.934746	1.403264	4.229243	0.0000
MONTH="June"	7.891826	1.347247	5.857742	0.0000
MONTH="Mar"	1.881959	1.910831	0.984890	0.3254
MONTH="May"	1.665044	1.356662	1.227309	0.2206

MONTH="Nov"	11.23937	1.420253	7.913642	0.0000
MONTH="Oct"	19.18657	1.276628	15.02910	0.0000
MONTH="Sept"	23.22526	1.512135	15.35925	0.0000

R-squared	0.705683	Mean dependent var	60.93992
Adjusted R-squared	0.666258	S.D. dependent var	11.02542
S.E. of regression	6.369433	Akaike info criterion	6.653538
Sum squared resid	13022.87	Schwarz criterion	7.123662
Log likelihood	-1170.271	Hannan-Quinn criter.	6.840371
F-statistic	17.89912	Durbin-Watson stat	0.851176
Prob(F-statistic)	0.000000	Wald F-statistic	29.88062
Prob(Wald F-statistic)	0.000000		

Dependent Variable: PRICE
Method: ARMA Conditional Least Squares (Gauss-Newton / Marquardt steps)
Sample (adjusted): 2 365
Included observations: 364 after adjustments
Convergence achieved after 8 iterations
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	21.48281	5.620786	3.822030	0.0002
LOAD	0.007469	0.000697	10.71234	0.0000
RES	-0.006242	0.000999	-6.246190	0.0000
DAY=2	3.392206	2.939657	1.153946	0.2494
DAY=3	0.070346	2.649888	0.026547	0.9788
DAY=4	-0.321081	2.893812	-0.110954	0.9117
DAY=5	-0.662144	3.015140	-0.219607	0.8263
DAY=6	-1.307666	3.115419	-0.419740	0.6750
DAY=7	-1.343370	2.999663	-0.447840	0.6546
DAY=8	-3.063610	2.830969	-1.082177	0.2800
DAY=9	-1.740846	2.914466	-0.597312	0.5507
DAY=10	-0.726105	3.061586	-0.237166	0.8127
DAY=11	-1.190011	3.142005	-0.378742	0.7051
DAY=12	-0.980240	3.038581	-0.322598	0.7472
DAY=13	-1.239176	2.913744	-0.425286	0.6709
DAY=14	-1.885968	2.792623	-0.675339	0.4999
DAY=15	-0.384797	2.824639	-0.136229	0.8917
DAY=16	-0.470744	2.816979	-0.167110	0.8674
DAY=17	-0.629015	2.929249	-0.214736	0.8301
DAY=18	-0.448970	2.808298	-0.159873	0.8731
DAY=19	0.771351	2.836836	0.271905	0.7859
DAY=20	0.883642	2.888900	0.305875	0.7599
DAY=21	2.938809	3.109859	0.944998	0.3454
DAY=22	2.153976	3.250691	0.662621	0.5081
DAY=23	1.683837	3.210245	0.524520	0.6003
DAY=24	2.661547	3.095059	0.859934	0.3905
DAY=25	0.309467	2.951741	0.104842	0.9166
DAY=26	4.873012	3.641054	1.338352	0.1817
DAY=27	4.144921	3.826942	1.083090	0.2796
DAY=28	0.726270	3.217785	0.225705	0.8216
DAY=29	0.172447	2.737273	0.062999	0.9498
DAY=30	1.480956	2.458754	0.602320	0.5474
DAY=31	0.947017	2.686473	0.352513	0.7247
MONTH="Aug"	14.80287	3.322434	4.455431	0.0000
MONTH="Dec"	9.975278	3.422201	2.914872	0.0038
MONTH="Feb"	-2.291389	4.689073	-0.488666	0.6254
MONTH="Jan"	-7.298111	3.664758	-1.991431	0.0473
MONTH="July"	7.443498	3.717508	2.002282	0.0461
MONTH="June"	6.213136	3.314346	1.874619	0.0618
MONTH="Mar"	2.916208	4.407522	0.661643	0.5087
MONTH="May"	1.800652	3.357603	0.536291	0.5921
MONTH="Nov"	11.58369	3.384701	3.422368	0.0007

MONTH="Oct"	19.19791	3.208177	5.984056	0.0000
MONTH="Sept"	22.45974	3.629986	6.187280	0.0000
AR(1)	0.600340	0.093157	6.444386	0.0000

R-squared	0.805634	Mean dependent var	60.98315
Adjusted R-squared	0.778825	S.D. dependent var	11.00958
S.E. of regression	5.177724	Akaike info criterion	6.241898
Sum squared resid	8552.015	Schwarz criterion	6.723689
Log likelihood	-1091.025	Hannan-Quinn criter.	6.433388
F-statistic	30.05074	Durbin-Watson stat	2.135764
Prob(F-statistic)	0.000000		

Inverted AR Roots	.60

MODEL 3

Dependent Variable: PRICE
Method: Least Squares
Date: 03/25/20 Time: 12:40
Sample: 1 365
Included observations: 365
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	22.98466	5.326784	4.314922	0.0000
LOAD	0.007325	0.000796	9.196648	0.0000
SOLAR	-0.004734	0.002169	-2.183197	0.0297
WIND	-0.009141	0.001510	-6.051859	0.0000
DAY=2	3.050084	4.794269	0.636194	0.5251
DAY=3	-0.185158	3.913482	-0.047313	0.9623
DAY=4	-1.269659	3.868041	-0.328243	0.7429
DAY=5	-1.758447	3.862329	-0.455282	0.6492
DAY=6	-2.389087	3.906768	-0.611525	0.5413
DAY=7	-2.401296	3.862214	-0.621741	0.5346
DAY=8	-4.310152	3.622341	-1.189880	0.2350
DAY=9	-3.006403	3.814240	-0.788205	0.4312
DAY=10	-2.185379	3.876427	-0.563761	0.5733
DAY=11	-2.623174	3.845984	-0.682055	0.4957
DAY=12	-1.917189	3.799556	-0.504582	0.6142
DAY=13	-2.436608	3.688926	-0.660520	0.5094
DAY=14	-3.185374	3.655420	-0.871411	0.3842
DAY=15	-1.376570	3.596905	-0.382709	0.7022
DAY=16	-1.388224	3.696638	-0.375537	0.7075
DAY=17	-1.742607	3.732893	-0.466825	0.6409
DAY=18	-1.235520	3.607789	-0.342459	0.7322
DAY=19	-0.165827	3.731827	-0.044436	0.9646
DAY=20	-0.236657	3.885789	-0.060903	0.9515
DAY=21	1.819256	3.860365	0.471265	0.6378
DAY=22	1.326878	3.845167	0.345077	0.7303
DAY=23	0.835791	3.720456	0.224647	0.8224
DAY=24	1.766524	3.773250	0.468170	0.6400
DAY=25	-0.355119	3.515471	-0.101016	0.9196
DAY=26	4.512814	4.391050	1.027730	0.3049
DAY=27	3.559397	5.299646	0.671629	0.5023
DAY=28	0.445569	4.116784	0.108232	0.9139
DAY=29	-1.725481	3.563595	-0.484197	0.6286
DAY=30	-0.278700	3.628773	-0.076803	0.9388
DAY=31	-1.305036	4.186588	-0.311718	0.7555
MONTH="Aug"	13.86433	1.392211	9.958497	0.0000
MONTH="Dec"	10.18161	1.314262	7.747022	0.0000
MONTH="Feb"	-0.674727	2.667070	-0.252984	0.8004
MONTH="Jan"	-6.760245	1.348293	-5.013928	0.0000
MONTH="July"	5.529655	1.471260	3.758447	0.0002
MONTH="June"	7.783366	1.348291	5.772764	0.0000

MONTH="Mar"	2.835276	1.928264	1.470377	0.1424
MONTH="May"	1.850875	1.322772	1.399239	0.1627
MONTH="Nov"	11.99003	1.383507	8.666400	0.0000
MONTH="Oct"	19.64367	1.240865	15.83062	0.0000
MONTH="Sept"	23.01089	1.577834	14.58385	0.0000

R-squared	0.709534	Mean dependent var	60.93992
Adjusted R-squared	0.669595	S.D. dependent var	11.02542
S.E. of regression	6.337507	Akaike info criterion	6.645847
Sum squared resid	12852.48	Schwarz criterion	7.126656
Log likelihood	-1167.867	Hannan-Quinn criter.	6.836927
F-statistic	17.76542	Durbin-Watson stat	0.851141
Prob(F-statistic)	0.000000	Wald F-statistic	29.38756
Prob(Wald F-statistic)	0.000000		

Dependent Variable: PRICE
Method: ARMA Conditional Least Squares (Gauss-Newton / Marquardt steps)
Sample (adjusted): 2 365
Included observations: 364 after adjustments
Convergence achieved after 8 iterations
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	20.04028	5.723780	3.501233	0.0005
LOAD	0.007550	0.000707	10.68261	0.0000
SOLAR	-0.003907	0.001499	-2.606936	0.0096
WIND	-0.007712	0.001328	-5.807384	0.0000
DAY=2	3.204426	2.932615	1.092686	0.2754
DAY=3	0.075761	2.637190	0.028728	0.9771
DAY=4	-0.647543	2.929837	-0.221017	0.8252
DAY=5	-1.108625	3.102154	-0.357373	0.7210
DAY=6	-1.711723	3.159528	-0.541766	0.5884
DAY=7	-1.748609	3.048908	-0.573520	0.5667
DAY=8	-3.625756	2.888814	-1.255102	0.2104
DAY=9	-2.290588	3.041433	-0.753128	0.4519
DAY=10	-1.484187	3.200292	-0.463766	0.6431
DAY=11	-1.770179	3.209552	-0.551535	0.5817
DAY=12	-1.322958	3.059291	-0.432439	0.6657
DAY=13	-1.845328	2.946451	-0.626288	0.5316
DAY=14	-2.406745	2.844466	-0.846115	0.3981
DAY=15	-0.742478	2.861356	-0.259485	0.7954
DAY=16	-0.783383	2.823432	-0.277458	0.7816
DAY=17	-1.024688	2.957318	-0.346492	0.7292
DAY=18	-0.743851	2.832463	-0.262616	0.7930
DAY=19	0.442160	2.876839	0.153696	0.8779
DAY=20	0.437847	2.938668	0.148995	0.8817
DAY=21	2.480731	3.174916	0.781353	0.4352
DAY=22	1.911528	3.278203	0.583102	0.5602
DAY=23	1.330003	3.280535	0.405422	0.6854
DAY=24	2.260365	3.153086	0.716874	0.4740
DAY=25	-0.056654	2.997234	-0.018902	0.9849
DAY=26	4.556908	3.600004	1.265806	0.2065
DAY=27	3.542574	3.730816	0.949544	0.3431
DAY=28	0.196711	3.199875	0.061475	0.9510
DAY=29	-0.421499	2.752573	-0.153129	0.8784
DAY=30	0.979347	2.490462	0.393239	0.6944
DAY=31	0.778727	2.703690	0.288024	0.7735
MONTH="Aug"	14.45569	3.418442	4.228735	0.0000
MONTH="Dec"	10.86584	3.426606	3.171021	0.0017
MONTH="Feb"	-1.439092	4.793237	-0.300234	0.7642
MONTH="Jan"	-6.644688	3.689990	-1.800733	0.0727
MONTH="July"	7.169590	3.769792	1.901853	0.0581
MONTH="June"	6.270102	3.329834	1.883007	0.0606

MONTH="Mar"	3.994145	4.508274	0.885959	0.3763
MONTH="May"	2.028781	3.357927	0.604177	0.5462
MONTH="Nov"	12.36612	3.388385	3.649563	0.0003
MONTH="Oct"	19.62278	3.191725	6.148017	0.0000
MONTH="Sept"	22.39724	3.695421	6.060810	0.0000
AR(1)	0.599116	0.091521	6.546213	0.0000

R-squared	0.808148	Mean dependent var	60.98315
Adjusted R-squared	0.780999	S.D. dependent var	11.00958
S.E. of regression	5.152215	Akaike info criterion	6.234375
Sum squared resid	8441.413	Schwarz criterion	6.726873
Log likelihood	-1088.656	Hannan-Quinn criter.	6.430121
F-statistic	29.76720	Durbin-Watson stat	2.157094
Prob(F-statistic)	0.000000		

Inverted AR Roots	.60

MODEL 4

Dependent Variable: PRICE
Method: Least Squares
Sample: 1 365
Included observations: 362
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3.679440	5.712440	-0.644110	0.5200
LOAD	0.004856	0.000457	10.61778	0.0000
SOLAR	-0.004585	0.001369	-3.348642	0.0009
WIND	-0.008283	0.000994	-8.333861	0.0000
GAS_PRICE	1.633417	0.201988	8.086725	0.0000
DAY=2	2.855409	2.852965	1.000857	0.3177
DAY=3	1.686329	2.399594	0.702756	0.4827
DAY=4	1.934598	2.723667	0.710292	0.4780
DAY=5	0.500573	2.309162	0.216777	0.8285
DAY=6	1.343438	2.492565	0.538978	0.5903
DAY=7	1.388050	2.475001	0.560828	0.5753
DAY=8	-0.920828	2.372783	-0.388079	0.6982
DAY=9	0.612741	2.469695	0.248104	0.8042
DAY=10	1.369991	2.606842	0.525537	0.5996
DAY=11	0.578098	2.497111	0.231507	0.8171
DAY=12	1.561314	2.375660	0.657213	0.5115
DAY=13	0.558627	2.436837	0.229243	0.8188
DAY=14	-0.615817	2.324786	-0.264892	0.7913
DAY=15	0.952899	2.371048	0.401889	0.6880
DAY=16	0.933831	2.461083	0.379439	0.7046
DAY=17	0.787283	2.405685	0.327259	0.7437
DAY=18	1.107989	2.323531	0.476856	0.6338
DAY=19	2.164187	2.302551	0.939908	0.3480
DAY=20	2.301269	2.623043	0.877328	0.3810
DAY=21	3.885268	2.597508	1.495767	0.1357
DAY=22	3.039809	2.738616	1.109980	0.2679
DAY=23	2.662715	2.444785	1.089141	0.2769
DAY=24	3.698513	2.479249	1.491788	0.1368
DAY=25	0.826066	2.408601	0.342965	0.7319
DAY=26	3.593850	2.676280	1.342853	0.1803
DAY=27	3.969706	2.969925	1.336635	0.1823
DAY=28	1.416333	2.413810	0.586762	0.5578
DAY=29	0.982659	2.491951	0.394333	0.6936
DAY=30	2.472172	2.458646	1.005501	0.3154
DAY=31	1.889797	2.766674	0.683058	0.4951
MONTH="Aug"	8.796067	1.361626	6.459973	0.0000
MONTH="Dec"	5.561886	1.272512	4.370794	0.0000
MONTH="Feb"	-0.066695	1.497220	-0.044546	0.9645

MONTH="Jan"	-2.073503	1.314347	-1.577592	0.1157
MONTH="July"	3.667117	1.292936	2.836271	0.0049
MONTH="June"	5.159263	1.367040	3.774039	0.0002
MONTH="Mar"	1.503806	1.222188	1.230421	0.2195
MONTH="May"	-0.268323	1.280994	-0.209465	0.8342
MONTH="Nov"	7.845478	1.343962	5.837573	0.0000
MONTH="Oct"	11.51081	1.460434	7.881771	0.0000
MONTH="Sept"	11.91184	2.001768	5.950659	0.0000

R-squared	0.867322	Mean dependent var	61.05294
Adjusted R-squared	0.848428	S.D. dependent var	10.98919
S.E. of regression	4.278336	Akaike info criterion	5.863247
Sum squared resid	5784.114	Schwarz criterion	6.357765
Log likelihood	-1015.248	Hannan-Quinn criter.	6.059836
F-statistic	45.90469	Durbin-Watson stat	1.658350
Prob(F-statistic)	0.000000	Wald F-statistic	55.40304
Prob(Wald F-statistic)	0.000000		

Dependent Variable: PRICE
Method: ARMA Conditional Least Squares (Gauss-Newton / Marquardt steps)
Sample (adjusted): 4 365
Included observations: 358 after adjustments
Convergence achieved after 7 iterations
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3.708355	6.164234	-0.601592	0.5479
LOAD	0.005112	0.000529	9.670197	0.0000
SOLAR	-0.004467	0.001378	-3.242188	0.0013
WIND	-0.008367	0.001024	-8.174337	0.0000
GAS_PRICE	1.557921	0.223553	6.968919	0.0000
DAY=2	3.283482	2.600278	1.262743	0.2076
DAY=3	1.668198	2.370946	0.703600	0.4822
DAY=4	1.680160	2.716047	0.618605	0.5366
DAY=5	0.632582	2.316316	0.273098	0.7850
DAY=6	1.470810	2.464718	0.596746	0.5511
DAY=7	1.534392	2.438771	0.629166	0.5297
DAY=8	-0.746581	2.336422	-0.319540	0.7495
DAY=9	0.770534	2.483540	0.310256	0.7566
DAY=10	1.510521	2.601400	0.580657	0.5619
DAY=11	0.758647	2.518241	0.301261	0.7634
DAY=12	1.707248	2.349006	0.726796	0.4679
DAY=13	0.724088	2.393465	0.302527	0.7625
DAY=14	-0.405923	2.278839	-0.178127	0.8587
DAY=15	1.191257	2.345081	0.507981	0.6118
DAY=16	1.162824	2.391346	0.486263	0.6271
DAY=17	0.999382	2.386135	0.418829	0.6756
DAY=18	1.332398	2.290958	0.581590	0.5613
DAY=19	2.368768	2.264137	1.046212	0.2963
DAY=20	2.495208	2.553799	0.977057	0.3293
DAY=21	4.114528	2.585600	1.591324	0.1126
DAY=22	3.292669	2.689208	1.224401	0.2217
DAY=23	2.904185	2.415004	1.202559	0.2301
DAY=24	3.954761	2.464110	1.604945	0.1095
DAY=25	1.139586	2.420938	0.470721	0.6382
DAY=26	3.975353	2.642348	1.504478	0.1335
DAY=27	4.267358	3.048091	1.400010	0.1625
DAY=28	1.678563	2.377831	0.705922	0.4808
DAY=29	1.220102	2.432424	0.501599	0.6163
DAY=30	2.779598	2.394137	1.161002	0.2465
DAY=31	2.098859	2.709363	0.774669	0.4391
MONTH="Aug"	9.204522	1.683500	5.467493	0.0000
MONTH="Dec"	6.039195	1.590348	3.797406	0.0002

MONTH="Feb"	0.054703	1.960209	0.027907	0.9778
MONTH="Jan"	-2.378932	1.644978	-1.446179	0.1491
MONTH="July"	3.941791	1.667227	2.364280	0.0187
MONTH="June"	5.308520	1.625868	3.265037	0.0012
MONTH="Mar"	1.816205	1.627001	1.116290	0.2652
MONTH="May"	0.039968	1.629604	0.024526	0.9804
MONTH="Nov"	8.206860	1.652782	4.965483	0.0000
MONTH="Oct"	12.08636	1.755269	6.885759	0.0000
MONTH="Sept"	12.58326	2.314729	5.436172	0.0000
AR(1)	0.178538	0.080992	2.204393	0.0282

R-squared	0.871367	Mean dependent var	61.17419
Adjusted R-squared	0.852341	S.D. dependent var	10.97972
S.E. of regression	4.219109	Akaike info criterion	5.838955
Sum squared resid	5536.075	Schwarz criterion	6.348410
Log likelihood	-998.1729	Hannan-Quinn criter.	6.041566
F-statistic	45.79865	Durbin-Watson stat	1.986709
Prob(F-statistic)	0.000000		

Inverted AR Roots	.18

TEST ON THE RESIDUALS

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.627612	Prob. F(2,310)	0.5345
Obs*R-squared	1.443735	Prob. Chi-Square(2)	0.4858

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 03/25/20 Time: 12:43
Sample: 4 365
Included observations: 358
Coefficient covariance computed using outer product of gradients
Presample and interior missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOAD	4.07E-05	0.000446	0.091344	0.9273
SOLAR	0.000108	0.001255	0.085807	0.9317
WIND	6.79E-05	0.000985	0.068966	0.9451
GAS_PRICE	-0.013207	0.086741	-0.152261	0.8791
DAY=2	0.192116	1.633973	0.117576	0.9065
DAY=3	0.041654	1.796969	0.023180	0.9815
DAY=4	0.334110	1.815932	0.183988	0.8541
DAY=5	0.308341	1.800281	0.171274	0.8641
DAY=6	0.155625	1.769711	0.087938	0.9300
DAY=7	0.100172	1.757769	0.056988	0.9546
DAY=8	0.087392	1.755954	0.049769	0.9603
DAY=9	0.083799	1.758441	0.047655	0.9620
DAY=10	0.077577	1.785781	0.043441	0.9654
DAY=11	0.095121	1.752830	0.054267	0.9568
DAY=12	0.078027	1.776048	0.043933	0.9650
DAY=13	0.076410	1.786767	0.042764	0.9659
DAY=14	0.095700	1.754471	0.054547	0.9565
DAY=15	0.090604	1.744997	0.051922	0.9586
DAY=16	0.089262	1.752665	0.050930	0.9594
DAY=17	0.094173	1.753154	0.053716	0.9572
DAY=18	0.081314	1.763936	0.046098	0.9633
DAY=19	0.089130	1.771458	0.050315	0.9599
DAY=20	0.090436	1.770534	0.051078	0.9593
DAY=21	0.094034	1.761241	0.053391	0.9575
DAY=22	0.096849	1.755819	0.055159	0.9560

DAY=23	0.089008	1.766136	0.050397	0.9598
DAY=24	0.090946	1.750587	0.051952	0.9586
DAY=25	0.089512	1.754054	0.051032	0.9593
DAY=26	0.098056	1.792675	0.054698	0.9564
DAY=27	0.094562	1.787349	0.052906	0.9578
DAY=28	0.111863	1.748513	0.063976	0.9490
DAY=29	0.207446	1.828278	0.113465	0.9097
DAY=30	0.092853	1.755514	0.052892	0.9579
DAY=31	-0.092586	1.937660	-0.047783	0.9619
MONTH="Aug"	-0.072997	1.404804	-0.051963	0.9586
MONTH="Dec"	-0.051231	1.453288	-0.035251	0.9719
MONTH="Feb"	-0.076544	1.504114	-0.050890	0.9594
MONTH="Jan"	-0.066073	1.485192	-0.044488	0.9645
MONTH="July"	-0.105460	1.442447	-0.073112	0.9418
MONTH="June"	-0.123516	1.391134	-0.088788	0.9293
MONTH="Mar"	-0.163519	1.451135	-0.112684	0.9104
MONTH="May"	-0.056249	1.355925	-0.041484	0.9669
MONTH="Nov"	-0.054795	1.434300	-0.038203	0.9696
MONTH="Oct"	-0.032583	1.465730	-0.022230	0.9823
MONTH="Sept"	-0.047504	1.521325	-0.031225	0.9751
AR(1)	-0.399528	0.609052	-0.655984	0.5123
RESID(-1)	0.394391	0.613766	0.642575	0.5210
RESID(-2)	0.131160	0.130410	1.005750	0.3153

R-squared	0.004004	Mean dependent var	-0.021146
Adjusted R-squared	-0.147002	S.D. dependent var	3.946003
S.E. of regression	4.226097	Akaike info criterion	5.844630
Sum squared resid	5536.567	Schwarz criterion	6.364925
Log likelihood	-998.1889	Hannan-Quinn criter.	6.051553
Durbin-Watson stat	1.971391		

SOUTH

MODEL 1

Dependent Variable: PRICE
Method: Least Squares
Sample: 1 365
Included observations: 365

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	17.65501	4.670301	3.780272	0.0002
LOAD	0.012353	0.001550	7.967437	0.0000
DAY=2	3.369545	2.921634	1.153308	0.2496
DAY=3	0.554859	2.924330	0.189739	0.8496
DAY=4	1.735871	2.921739	0.594123	0.5528
DAY=5	0.516069	2.928091	0.176248	0.8602
DAY=6	1.534270	2.921661	0.525136	0.5998
DAY=7	1.559165	2.921942	0.533606	0.5940
DAY=8	-1.971055	2.922757	-0.674382	0.5006
DAY=9	1.047561	2.922095	0.358497	0.7202
DAY=10	1.031664	2.922259	0.353037	0.7243
DAY=11	1.425307	2.921671	0.487840	0.6260
DAY=12	0.389671	2.923177	0.133304	0.8940
DAY=13	0.830200	2.921799	0.284140	0.7765
DAY=14	0.160633	2.921724	0.054979	0.9562
DAY=15	0.212260	2.922575	0.072628	0.9421
DAY=16	2.063929	2.924025	0.705852	0.4808
DAY=17	0.479705	2.922887	0.164120	0.8697
DAY=18	-0.618237	2.922805	-0.211522	0.8326
DAY=19	0.971105	2.923011	0.332228	0.7399
DAY=20	2.770895	2.921651	0.948400	0.3436
DAY=21	3.642417	2.922228	1.246452	0.2135
DAY=22	2.622035	2.921651	0.897450	0.3701

DAY=23	1.768839	2.922773	0.605192	0.5455
DAY=24	2.427438	2.921639	0.830848	0.4067
DAY=25	-0.209605	2.927928	-0.071588	0.9430
DAY=26	0.120150	2.921635	0.041124	0.9672
DAY=27	1.355213	2.921746	0.463837	0.6431
DAY=28	0.716815	2.921782	0.245335	0.8064
DAY=29	-3.808903	2.989899	-1.273924	0.2036
DAY=30	0.509975	2.990124	0.170553	0.8647
DAY=31	-0.936278	3.423763	-0.273465	0.7847
MONTH="Aug"	1.138325	2.593456	0.438922	0.6610
MONTH="Dec"	6.044294	1.988566	3.039524	0.0026
MONTH="Feb"	-1.086579	2.005813	-0.541715	0.5884
MONTH="Jan"	-7.559824	1.927240	-3.922616	0.0001
MONTH="July"	-0.705870	2.409000	-0.293014	0.7697
MONTH="June"	2.050657	2.045385	1.002578	0.3168
MONTH="Mar"	-1.517658	1.895000	-0.800875	0.4238
MONTH="May"	3.504989	1.838521	1.906418	0.0575
MONTH="Nov"	8.560096	1.930540	4.434043	0.0000
MONTH="Oct"	14.87721	1.870168	7.955014	0.0000
MONTH="Sept"	10.85747	2.197187	4.941532	0.0000

R-squared	0.574553	Mean dependent var	59.37493
Adjusted R-squared	0.519059	S.D. dependent var	10.31943
S.E. of regression	7.156513	Akaike info criterion	6.884193
Sum squared resid	16491.45	Schwarz criterion	7.343633
Log likelihood	-1213.365	Hannan-Quinn criter.	7.066781
F-statistic	10.35358	Durbin-Watson stat	0.873456
Prob(F-statistic)	0.000000		

Dependent Variable: PRICE
Method: ARMA Conditional Least Squares (Gauss-Newton / Marquardt steps)
Sample (adjusted): 2 365
Included observations: 364 after adjustments
Convergence achieved after 7 iterations
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	22.24024	6.354296	3.500033	0.0005
LOAD	0.010188	0.001514	6.729795	0.0000
DAY=2	3.646590	2.689670	1.355776	0.1761
DAY=3	1.173993	2.638010	0.445030	0.6566
DAY=4	2.312030	3.106760	0.744193	0.4573
DAY=5	1.386912	3.215148	0.431368	0.6665
DAY=6	2.185394	3.357671	0.650866	0.5156
DAY=7	2.153920	3.205807	0.671881	0.5021
DAY=8	-1.418187	3.268993	-0.433830	0.6647
DAY=9	1.648195	3.411039	0.483194	0.6293
DAY=10	1.624607	3.183729	0.510284	0.6102
DAY=11	2.084654	3.299929	0.631727	0.5280
DAY=12	1.203422	3.294267	0.365308	0.7151
DAY=13	1.555419	3.389067	0.458952	0.6466
DAY=14	0.810902	3.248618	0.249614	0.8030
DAY=15	0.790837	3.262776	0.242382	0.8086
DAY=16	2.580498	3.298029	0.782436	0.4345
DAY=17	1.040898	3.292253	0.316166	0.7521
DAY=18	-0.054775	3.555914	-0.015404	0.9877
DAY=19	1.772330	3.462662	0.511840	0.6091
DAY=20	3.455352	3.262870	1.058992	0.2904
DAY=21	4.222242	3.413977	1.236752	0.2171
DAY=22	3.255653	3.381890	0.962673	0.3364
DAY=23	2.505230	3.376660	0.741926	0.4587
DAY=24	3.000713	3.296742	0.910206	0.3634

DAY=25	0.031787	3.311407	0.009599	0.9923
DAY=26	0.511333	4.021949	0.127136	0.8989
DAY=27	1.577355	4.305271	0.366378	0.7143
DAY=28	0.519670	3.888605	0.133639	0.8938
DAY=29	-2.408859	3.315190	-0.726613	0.4680
DAY=30	1.866529	2.775003	0.672622	0.5017
DAY=31	1.433281	3.058579	0.468610	0.6397
MONTH="Aug"	5.815905	3.956523	1.469954	0.1426
MONTH="Dec"	7.643827	3.981678	1.919750	0.0558
MONTH="Feb"	-0.995240	4.929789	-0.201883	0.8401
MONTH="Jan"	-5.605047	3.909393	-1.433739	0.1526
MONTH="July"	2.606427	4.140504	0.629495	0.5295
MONTH="June"	2.175247	3.840543	0.566390	0.5715
MONTH="Mar"	0.636761	4.620025	0.137826	0.8905
MONTH="May"	3.651954	3.755753	0.972363	0.3316
MONTH="Nov"	9.899126	3.468776	2.853781	0.0046
MONTH="Oct"	15.20288	4.003170	3.797711	0.0002
MONTH="Sept"	11.47584	4.109850	2.792277	0.0055
AR(1)	0.592161	0.078941	7.501346	0.0000

R-squared	0.713315	Mean dependent var	59.41386
Adjusted R-squared	0.674792	S.D. dependent var	10.30676
S.E. of regression	5.877638	Akaike info criterion	6.493112
Sum squared resid	11054.92	Schwarz criterion	6.964197
Log likelihood	-1137.746	Hannan-Quinn criter.	6.680347
F-statistic	18.51647	Durbin-Watson stat	2.032538
Prob(F-statistic)	0.000000		

Inverted AR Roots	.59

MODEL 2

Dependent Variable: PRICE
Method: Least Squares
Sample: 1 365
Included observations: 365
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	27.80879	5.288180	5.258669	0.0000
LOAD	0.012042	0.001469	8.196266	0.0000
RES	-0.005588	0.000574	-9.742623	0.0000
DAY=2	4.135069	4.331007	0.954759	0.3404
DAY=3	2.415895	3.614858	0.668324	0.5044
DAY=4	1.289447	3.389203	0.380457	0.7039
DAY=5	0.190409	3.420229	0.055671	0.9556
DAY=6	1.495099	3.367835	0.443935	0.6574
DAY=7	2.038927	3.329080	0.612460	0.5407
DAY=8	-0.342624	3.228911	-0.106111	0.9156
DAY=9	1.196689	3.587742	0.333549	0.7389
DAY=10	0.654309	3.179303	0.205803	0.8371
DAY=11	0.924161	3.429413	0.269481	0.7877
DAY=12	0.335642	3.322988	0.101006	0.9196
DAY=13	1.158496	3.379387	0.342812	0.7320
DAY=14	-0.649190	3.234871	-0.200685	0.8411
DAY=15	1.113174	3.203255	0.347513	0.7284
DAY=16	2.945002	3.197899	0.920918	0.3578
DAY=17	0.040037	3.344038	0.011973	0.9905
DAY=18	0.876061	3.422887	0.255942	0.7982
DAY=19	1.813512	3.301633	0.549277	0.5832
DAY=20	2.353919	3.278025	0.718091	0.4732
DAY=21	3.619710	3.321143	1.089899	0.2766
DAY=22	3.313637	3.250811	1.019326	0.3088
DAY=23	2.836945	3.469369	0.817712	0.4141

DAY=24	4.379420	3.438877	1.273503	0.2038
DAY=25	1.586691	3.391959	0.467780	0.6403
DAY=26	3.189410	3.749690	0.850580	0.3956
DAY=27	2.962736	5.011162	0.591227	0.5548
DAY=28	2.254063	4.271163	0.527740	0.5980
DAY=29	-2.297239	4.082284	-0.562734	0.5740
DAY=30	0.698744	3.615093	0.193285	0.8469
DAY=31	0.887159	4.032778	0.219987	0.8260
MONTH="Aug"	0.129966	2.033299	0.063919	0.9491
MONTH="Dec"	6.653126	1.305948	5.094479	0.0000
MONTH="Feb"	-0.613794	2.188203	-0.280501	0.7793
MONTH="Jan"	-6.821579	1.308813	-5.212033	0.0000
MONTH="July"	1.058720	1.725258	0.613659	0.5399
MONTH="June"	3.766370	1.303001	2.890536	0.0041
MONTH="Mar"	1.493186	1.881406	0.793654	0.4280
MONTH="May"	2.244859	1.344611	1.669524	0.0960
MONTH="Nov"	6.715290	1.238581	5.421762	0.0000
MONTH="Oct"	14.50438	1.838263	7.890261	0.0000
MONTH="Sept"	10.97751	1.706367	6.433263	0.0000

R-squared	0.684962	Mean dependent var	59.37493
Adjusted R-squared	0.642760	S.D. dependent var	10.31943
S.E. of regression	6.167876	Akaike info criterion	6.589226
Sum squared resid	12211.71	Schwarz criterion	7.059351
Log likelihood	-1158.534	Hannan-Quinn criter.	6.776060
F-statistic	16.23078	Durbin-Watson stat	0.919392
Prob(F-statistic)	0.000000	Wald F-statistic	31.57784
Prob(Wald F-statistic)	0.000000		

Dependent Variable: PRICE
Method: ARMA Conditional Least Squares (Gauss-Newton / Marquardt steps)
Sample (adjusted): 2 365
Included observations: 364 after adjustments
Convergence achieved after 7 iterations
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	27.50319	5.827917	4.719214	0.0000
LOAD	0.011251	0.001380	8.154933	0.0000
RES	-0.004920	0.000489	-10.05947	0.0000
DAY=2	4.448395	2.779922	1.600187	0.1105
DAY=3	2.895208	2.642730	1.095537	0.2741
DAY=4	2.120756	2.831744	0.748922	0.4545
DAY=5	1.171167	2.849619	0.410991	0.6814
DAY=6	2.385992	2.806930	0.850036	0.3959
DAY=7	2.861905	2.740008	1.044488	0.2971
DAY=8	0.335603	2.710419	0.123820	0.9015
DAY=9	2.074940	3.092111	0.671043	0.5027
DAY=10	1.595243	2.842929	0.561127	0.5751
DAY=11	1.906738	2.975167	0.640884	0.5221
DAY=12	1.324546	2.865126	0.462299	0.6442
DAY=13	2.068253	2.847036	0.726458	0.4681
DAY=14	0.368310	2.796670	0.131696	0.8953
DAY=15	1.898723	2.672938	0.710350	0.4780
DAY=16	3.709261	2.690070	1.378871	0.1689
DAY=17	0.979325	2.882351	0.339766	0.7343
DAY=18	1.584704	3.026878	0.523544	0.6010
DAY=19	2.690701	2.921526	0.920992	0.3578
DAY=20	3.336449	2.771715	1.203749	0.2296
DAY=21	4.513693	2.848185	1.584761	0.1140
DAY=22	4.140013	2.841009	1.457233	0.1460
DAY=23	3.652317	2.967369	1.230827	0.2193

DAY=24	5.016665	2.823364	1.776840	0.0765
DAY=25	2.096680	2.904494	0.721875	0.4709
DAY=26	3.568587	3.394083	1.051414	0.2939
DAY=27	3.385259	3.930077	0.861372	0.3897
DAY=28	2.400247	3.419000	0.702032	0.4832
DAY=29	-0.760352	2.913491	-0.260976	0.7943
DAY=30	2.244341	2.527516	0.887963	0.3752
DAY=31	2.814618	2.619911	1.074318	0.2835
MONTH="Aug"	3.147222	3.545702	0.887616	0.3754
MONTH="Dec"	7.417611	3.223206	2.301315	0.0220
MONTH="Feb"	-0.359826	4.273748	-0.084195	0.9330
MONTH="Jan"	-6.331964	3.470729	-1.824390	0.0690
MONTH="July"	2.386735	3.676992	0.649100	0.5167
MONTH="June"	3.223576	3.174957	1.015313	0.3107
MONTH="Mar"	2.586163	4.158347	0.621921	0.5344
MONTH="May"	2.362707	3.362821	0.702597	0.4828
MONTH="Nov"	8.118570	3.132647	2.591600	0.0100
MONTH="Oct"	14.41792	3.569675	4.039002	0.0001
MONTH="Sept"	10.97058	3.514183	3.121802	0.0020
AR(1)	0.565587	0.086025	6.574666	0.0000

R-squared	0.779841	Mean dependent var	59.41386
Adjusted R-squared	0.749475	S.D. dependent var	10.30676
S.E. of regression	5.158792	Akaike info criterion	6.234572
Sum squared resid	8489.591	Schwarz criterion	6.716363
Log likelihood	-1089.692	Hannan-Quinn criter.	6.426062
F-statistic	25.68080	Durbin-Watson stat	2.139562
Prob(F-statistic)	0.000000		

Inverted AR Roots	.57

MODEL 3

Dependent Variable: PRICE
Method: Least Squares
Sample: 1 365
Included observations: 365
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	26.00563	5.458568	4.764186	0.0000
LOAD	0.012103	0.001461	8.285897	0.0000
SOLAR	-0.003640	0.001891	-1.925253	0.0551
WIND	-0.005701	0.000582	-9.796658	0.0000
DAY=2	4.138025	4.350816	0.951092	0.3423
DAY=3	2.515389	3.674392	0.684573	0.4941
DAY=4	1.156078	3.429293	0.337118	0.7362
DAY=5	0.035839	3.493798	0.010258	0.9918
DAY=6	1.391738	3.415326	0.407498	0.6839
DAY=7	1.806572	3.350073	0.539264	0.5901
DAY=8	-0.686341	3.245422	-0.211480	0.8326
DAY=9	0.929300	3.632564	0.255825	0.7983
DAY=10	0.447968	3.199253	0.140023	0.8887
DAY=11	0.484845	3.434265	0.141179	0.8878
DAY=12	-0.056339	3.330503	-0.016916	0.9865
DAY=13	0.961256	3.409933	0.281899	0.7782
DAY=14	-0.793136	3.267804	-0.242712	0.8084
DAY=15	1.107239	3.250717	0.340614	0.7336
DAY=16	2.815457	3.232805	0.870902	0.3845
DAY=17	-0.081302	3.373670	-0.024099	0.9808
DAY=18	0.708906	3.441987	0.205958	0.8370
DAY=19	1.572438	3.320169	0.473602	0.6361
DAY=20	2.193791	3.296317	0.665528	0.5062

DAY=21	3.458642	3.338522	1.035980	0.3010
DAY=22	3.194656	3.278978	0.974284	0.3307
DAY=23	2.856782	3.497242	0.816867	0.4146
DAY=24	4.054595	3.453411	1.174084	0.2412
DAY=25	1.368598	3.399731	0.402561	0.6875
DAY=26	3.019800	3.802534	0.794155	0.4277
DAY=27	2.769113	5.080528	0.545044	0.5861
DAY=28	2.002933	4.235721	0.472867	0.6366
DAY=29	-2.632398	4.099071	-0.642194	0.5212
DAY=30	0.367681	3.640120	0.101008	0.9196
DAY=31	0.567027	4.040629	0.140331	0.8885
MONTH="Aug"	0.013506	2.033772	0.006641	0.9947
MONTH="Dec"	7.386596	1.477756	4.998521	0.0000
MONTH="Feb"	0.108795	2.250772	0.048337	0.9615
MONTH="Jan"	-6.223360	1.453708	-4.281024	0.0000
MONTH="July"	0.758981	1.717311	0.441959	0.6588
MONTH="June"	3.845340	1.310760	2.933671	0.0036
MONTH="Mar"	1.961617	1.854693	1.057651	0.2910
MONTH="May"	2.299878	1.342111	1.713627	0.0876
MONTH="Nov"	7.545599	1.473465	5.120989	0.0000
MONTH="Oct"	14.88179	1.693372	8.788257	0.0000
MONTH="Sept"	10.80550	1.719125	6.285464	0.0000

R-squared	0.686762	Mean dependent var	59.37493
Adjusted R-squared	0.643691	S.D. dependent var	10.31943
S.E. of regression	6.159834	Akaike info criterion	6.588976
Sum squared resid	12141.94	Schwarz criterion	7.069785
Log likelihood	-1157.488	Hannan-Quinn criter.	6.780056
F-statistic	15.94513	Durbin-Watson stat	0.904442
Prob(F-statistic)	0.000000	Wald F-statistic	31.06699
Prob(Wald F-statistic)	0.000000		

Dependent Variable: PRICE
Method: ARMA Conditional Least Squares (Gauss-Newton / Marquardt steps)
Sample (adjusted): 2 365
Included observations: 364 after adjustments
Convergence achieved after 7 iterations
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	24.43679	5.930273	4.120685	0.0000
LOAD	0.011491	0.001379	8.335414	0.0000
SOLAR	-0.001856	0.001345	-1.379948	0.1686
WIND	-0.005174	0.000500	-10.35291	0.0000
DAY=2	4.441770	2.694577	1.648411	0.1003
DAY=3	3.038382	2.627420	1.156413	0.2484
DAY=4	1.866237	2.882097	0.647527	0.5178
DAY=5	0.868312	2.959216	0.293426	0.7694
DAY=6	2.187330	2.884833	0.758217	0.4489
DAY=7	2.468493	2.828457	0.872735	0.3835
DAY=8	-0.217630	2.761316	-0.078814	0.9372
DAY=9	1.623114	3.179906	0.510428	0.6101
DAY=10	1.236041	2.925919	0.422445	0.6730
DAY=11	1.166838	3.003754	0.388460	0.6979
DAY=12	0.656564	2.890594	0.227138	0.8205
DAY=13	1.724896	2.904496	0.593871	0.5530
DAY=14	0.100983	2.864763	0.035250	0.9719
DAY=15	1.880752	2.746925	0.684675	0.4940
DAY=16	3.496103	2.730158	1.280550	0.2013
DAY=17	0.758876	2.903185	0.261394	0.7940
DAY=18	1.315219	3.053458	0.430731	0.6670
DAY=19	2.276977	2.938587	0.774854	0.4390

DAY=20	3.043285	2.802639	1.085864	0.2784
DAY=21	4.229307	2.890140	1.463357	0.1444
DAY=22	3.925953	2.919214	1.344866	0.1796
DAY=23	3.654595	3.070371	1.190278	0.2348
DAY=24	4.478276	2.886870	1.551257	0.1218
DAY=25	1.736935	2.938126	0.591171	0.5548
DAY=26	3.271728	3.447314	0.949066	0.3433
DAY=27	3.007402	3.949583	0.761448	0.4470
DAY=28	1.902435	3.489218	0.545232	0.5860
DAY=29	-1.381332	2.963056	-0.466185	0.6414
DAY=30	1.716734	2.567734	0.668579	0.5042
DAY=31	2.309434	2.636293	0.876015	0.3817
MONTH="Aug"	2.785485	3.660362	0.760986	0.4472
MONTH="Dec"	8.616418	3.321891	2.593829	0.0099
MONTH="Feb"	0.485860	4.419638	0.109932	0.9125
MONTH="Jan"	-5.600407	3.518377	-1.591759	0.1124
MONTH="July"	1.808678	3.782336	0.478191	0.6328
MONTH="June"	3.117087	3.284065	0.949155	0.3433
MONTH="Mar"	3.584520	4.338084	0.826291	0.4093
MONTH="May"	2.344450	3.494099	0.670974	0.5027
MONTH="Nov"	9.354099	3.255232	2.873559	0.0043
MONTH="Oct"	14.72975	3.544214	4.156000	0.0000
MONTH="Sept"	10.55587	3.670248	2.876065	0.0043
AR(1)	0.576407	0.086406	6.670941	0.0000

R-squared	0.784403	Mean dependent var	59.41386
Adjusted R-squared	0.753894	S.D. dependent var	10.30676
S.E. of regression	5.113084	Akaike info criterion	6.219127
Sum squared resid	8313.673	Schwarz criterion	6.711625
Log likelihood	-1085.881	Hannan-Quinn criter.	6.414872
F-statistic	25.71059	Durbin-Watson stat	2.161445
Prob(F-statistic)	0.000000		

Inverted AR Roots	.58

MODEL 4

Dependent Variable: PRICE
Method: Least Squares
Sample: 1 365
Included observations: 364
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.695126	5.894074	-0.287598	0.7738
LOAD	0.008098	0.000996	8.134220	0.0000
SOLAR	-0.000156	0.001265	-0.123434	0.9018
WIND	-0.005377	0.000437	-12.30023	0.0000
GAS_PRICE	1.528343	0.188079	8.126055	0.0000
DAY=2	2.976928	2.554606	1.165318	0.2448
DAY=3	4.248328	2.544144	1.669846	0.0959
DAY=4	3.380346	2.622003	1.289223	0.1983
DAY=5	1.473086	2.413299	0.610403	0.5420
DAY=6	3.718233	2.531133	1.468999	0.1428
DAY=7	4.012213	2.447235	1.639488	0.1021
DAY=8	1.003888	2.461339	0.407863	0.6836
DAY=9	3.022002	2.722693	1.109931	0.2679
DAY=10	2.404350	2.370517	1.014272	0.3112
DAY=11	2.062997	2.466469	0.836417	0.4035
DAY=12	1.739060	2.371192	0.733412	0.4638
DAY=13	2.547041	2.613343	0.974630	0.3305
DAY=14	0.670551	2.357042	0.284489	0.7762
DAY=15	2.571934	2.407973	1.068091	0.2863
DAY=16	3.782557	2.369497	1.596355	0.1114

DAY=17	1.139518	2.482298	0.459058	0.6465
DAY=18	1.685850	2.659449	0.633909	0.5266
DAY=19	2.505583	2.428425	1.031773	0.3030
DAY=20	3.356893	2.398991	1.399294	0.1627
DAY=21	4.215231	2.425033	1.738216	0.0831
DAY=22	3.769889	2.456061	1.534933	0.1258
DAY=23	3.982865	2.441155	1.631550	0.1038
DAY=24	4.794423	2.509897	1.910207	0.0570
DAY=25	1.559742	2.526050	0.617463	0.5374
DAY=26	1.270718	2.815722	0.451294	0.6521
DAY=27	2.177745	3.009548	0.723612	0.4698
DAY=28	1.751342	2.970822	0.589514	0.5559
DAY=29	-1.195348	3.201740	-0.373343	0.7091
DAY=30	1.922354	2.691051	0.714350	0.4755
DAY=31	2.443388	2.833679	0.862267	0.3892
MONTH="Aug"	-0.567582	1.468097	-0.386611	0.6993
MONTH="Dec"	5.162706	1.293900	3.990035	0.0001
MONTH="Feb"	1.594346	1.464512	1.088654	0.2771
MONTH="Jan"	-0.906782	1.406762	-0.644588	0.5197
MONTH="July"	0.414462	1.413832	0.293148	0.7696
MONTH="June"	2.987267	1.210638	2.467514	0.0141
MONTH="Mar"	1.139594	1.295430	0.879703	0.3797
MONTH="May"	0.361701	1.356534	0.266636	0.7899
MONTH="Nov"	5.695153	1.277120	4.459373	0.0000
MONTH="Oct"	8.170574	1.762346	4.636191	0.0000
MONTH="Sept"	2.554731	1.842196	1.386786	0.1665

R-squared	0.841932	Mean dependent var	59.39217
Adjusted R-squared	0.819564	S.D. dependent var	10.32837
S.E. of regression	4.387260	Akaike info criterion	5.912932
Sum squared resid	6120.881	Schwarz criterion	6.405429
Log likelihood	-1030.154	Hannan-Quinn criter.	6.108677
F-statistic	37.63989	Durbin-Watson stat	1.615542
Prob(F-statistic)	0.000000	Wald F-statistic	48.92926
Prob(Wald F-statistic)	0.000000		

Dependent Variable: PRICE
Method: ARMA Conditional Least Squares (Gauss-Newton / Marquardt steps)
Date: 04/01/20 Time: 13:52
Sample (adjusted): 2 365
Included observations: 362 after adjustments
Convergence achieved after 7 iterations
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.438005	6.410539	-0.224319	0.8227
LOAD	0.008407	0.001095	7.680726	0.0000
SOLAR	-0.000319	0.001182	-0.269763	0.7875
WIND	-0.005328	0.000438	-12.16775	0.0000
GAS_PRICE	1.452217	0.207750	6.990219	0.0000
DAY=2	3.473194	2.236333	1.553075	0.1214
DAY=3	4.781638	2.530549	1.889565	0.0597
DAY=4	3.376287	2.593024	1.302066	0.1938
DAY=5	1.862317	2.376423	0.783664	0.4338
DAY=6	4.143900	2.455665	1.687486	0.0925
DAY=7	4.459730	2.406871	1.852916	0.0648
DAY=8	1.472823	2.417741	0.609173	0.5428
DAY=9	3.483785	2.731368	1.275472	0.2031
DAY=10	2.877848	2.361853	1.218470	0.2240
DAY=11	2.559644	2.463760	1.038918	0.2996
DAY=12	2.211083	2.344606	0.943051	0.3464
DAY=13	3.024623	2.553000	1.184733	0.2370

DAY=14	1.169152	2.311292	0.505843	0.6133
DAY=15	3.051519	2.337099	1.305687	0.1926
DAY=16	4.293453	2.336090	1.837880	0.0670
DAY=17	1.649895	2.457079	0.671486	0.5024
DAY=18	2.187989	2.637851	0.829459	0.4075
DAY=19	3.007053	2.378014	1.264523	0.2070
DAY=20	3.864275	2.354880	1.640965	0.1018
DAY=21	4.743305	2.408302	1.969564	0.0498
DAY=22	4.294580	2.427188	1.769365	0.0778
DAY=23	4.465958	2.435154	1.833953	0.0676
DAY=24	5.302049	2.432388	2.179771	0.0300
DAY=25	2.106636	2.513505	0.838127	0.4026
DAY=26	1.885559	2.773008	0.679969	0.4970
DAY=27	2.750524	3.135310	0.877273	0.3810
DAY=28	2.315788	2.899225	0.798761	0.4250
DAY=29	-0.701822	2.938502	-0.238837	0.8114
DAY=30	2.346660	2.484216	0.944628	0.3456
DAY=31	2.821344	2.706294	1.042512	0.2980
MONTH="Aug"	-0.279443	1.848517	-0.151171	0.8799
MONTH="Dec"	5.509204	1.633739	3.372144	0.0008
MONTH="Feb"	1.723192	1.936906	0.889663	0.3743
MONTH="Jan"	-1.289712	1.735292	-0.743224	0.4579
MONTH="July"	0.605733	1.875549	0.322963	0.7469
MONTH="June"	3.073208	1.566345	1.962026	0.0506
MONTH="Mar"	1.473918	1.760213	0.837352	0.4030
MONTH="May"	0.703244	1.793428	0.392123	0.6952
MONTH="Nov"	6.049793	1.613787	3.748818	0.0002
MONTH="Oct"	8.645682	2.094396	4.128007	0.0000
MONTH="Sept"	3.138201	2.223850	1.411157	0.1592
AR(1)	0.197956	0.092376	2.142931	0.0329

R-squared	0.848984	Mean dependent var	59.43891
Adjusted R-squared	0.826931	S.D. dependent var	10.32888
S.E. of regression	4.296980	Akaike info criterion	5.874299
Sum squared resid	5816.171	Schwarz criterion	6.379567
Log likelihood	-1016.248	Hannan-Quinn criter.	6.075161
F-statistic	38.49718	Durbin-Watson stat	1.982503
Prob(F-statistic)	0.000000		

Inverted AR Roots	.20

TEST ON THE RESIDUALS

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.538014	Prob. F(2,313)	0.5844
Obs*R-squared	1.240217	Prob. Chi-Square(2)	0.5379

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Sample: 2 365
Included observations: 362
Coefficient covariance computed using outer product of gradients
Presample and interior missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.120632	3.774380	-0.031961	0.9745
LOAD	0.000106	0.001064	0.100096	0.9203
SOLAR	4.52E-05	0.001136	0.039810	0.9683
WIND	2.53E-05	0.000408	0.062053	0.9506
GAS_PRICE	-0.008801	0.098546	-0.089304	0.9289
DAY=2	0.324160	1.669093	0.194213	0.8461
DAY=3	0.072488	1.846545	0.039256	0.9687
DAY=4	0.140845	1.873094	0.075194	0.9401

DAY=5	0.215555	1.848580	0.116606	0.9072
DAY=6	0.112455	1.837312	0.061206	0.9512
DAY=7	0.065450	1.839506	0.035580	0.9716
DAY=8	0.048543	1.847059	0.026281	0.9790
DAY=9	0.050185	1.839767	0.027278	0.9783
DAY=10	0.054380	1.837303	0.029598	0.9764
DAY=11	0.050298	1.845724	0.027251	0.9783
DAY=12	0.041829	1.843561	0.022689	0.9819
DAY=13	0.047949	1.835206	0.026127	0.9792
DAY=14	0.058399	1.834150	0.031840	0.9746
DAY=15	0.054652	1.836567	0.029758	0.9763
DAY=16	0.057629	1.837317	0.031366	0.9750
DAY=17	0.061539	1.834449	0.033546	0.9733
DAY=18	0.051817	1.839207	0.028174	0.9775
DAY=19	0.045147	1.836551	0.024582	0.9804
DAY=20	0.056074	1.833097	0.030590	0.9756
DAY=21	0.059906	1.833774	0.032668	0.9740
DAY=22	0.055435	1.833454	0.030235	0.9759
DAY=23	0.048104	1.835183	0.026212	0.9791
DAY=24	0.043851	1.844486	0.023774	0.9810
DAY=25	0.059588	1.846176	0.032276	0.9743
DAY=26	0.055300	1.852523	0.029851	0.9762
DAY=27	0.056427	1.835298	0.030745	0.9755
DAY=28	0.065921	1.821223	0.036196	0.9711
DAY=29	0.133578	1.869912	0.071435	0.9431
DAY=30	0.025727	1.787154	0.014395	0.9885
DAY=31	-0.014781	1.975789	-0.007481	0.9940
MONTH="Aug"	-0.177004	1.869033	-0.094703	0.9246
MONTH="Dec"	-0.103948	1.561900	-0.066552	0.9470
MONTH="Feb"	-0.092064	1.568917	-0.058680	0.9532
MONTH="Jan"	-0.023699	1.536488	-0.015424	0.9877
MONTH="July"	-0.184984	1.761614	-0.105008	0.9164
MONTH="June"	-0.156311	1.540803	-0.101448	0.9193
MONTH="Mar"	-0.160270	1.475913	-0.108591	0.9136
MONTH="May"	-0.080804	1.406283	-0.057460	0.9542
MONTH="Nov"	-0.101460	1.547113	-0.065580	0.9478
MONTH="Oct"	-0.066196	1.501368	-0.044090	0.9649
MONTH="Sept"	-0.126320	1.707587	-0.073976	0.9411
AR(1)	-0.334716	0.448468	-0.746354	0.4560
RESID(-1)	0.331879	0.453616	0.731629	0.4649
RESID(-2)	0.110059	0.107664	1.022238	0.3075

R-squared	0.003426	Mean dependent var	-2.15E-11
Adjusted R-squared	-0.149403	S.D. dependent var	4.013885
S.E. of regression	4.303296	Akaike info criterion	5.881917
Sum squared resid	5796.244	Schwarz criterion	6.408686
Log likelihood	-1015.627	Hannan-Quinn criter.	6.091327
F-statistic	0.022417	Durbin-Watson stat	1.971334
Prob(F-statistic)	1.000000		

SICILY

MODEL 1

Dependent Variable: PRICE
Method: Least Squares
Sample: 1 365
Included observations: 365

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-29.75389	9.866402	-3.015678	0.0028
LOAD	0.046217	0.005234	8.830595	0.0000
DAY=2	1.119901	4.714205	0.237559	0.8124
DAY=3	-0.160218	4.734213	-0.033843	0.9730
DAY=4	4.497376	4.721255	0.952581	0.3415
DAY=5	9.400072	4.730850	1.986973	0.0478
DAY=6	5.641428	4.722198	1.194661	0.2331
DAY=7	0.435767	4.729967	0.092129	0.9267
DAY=8	2.536315	4.717798	0.537606	0.5912
DAY=9	4.512053	4.751110	0.949684	0.3430
DAY=10	4.307247	4.743962	0.907943	0.3646
DAY=11	4.132719	4.726790	0.874318	0.3826
DAY=12	3.184905	4.749919	0.670518	0.5030
DAY=13	-1.122860	4.747844	-0.236499	0.8132
DAY=14	-0.660275	4.734002	-0.139475	0.8892
DAY=15	-1.513334	4.717408	-0.320798	0.7486
DAY=16	3.129096	4.723835	0.662406	0.5082
DAY=17	-0.697169	4.725744	-0.147526	0.8828
DAY=18	-1.542241	4.726388	-0.326304	0.7444
DAY=19	1.883444	4.744603	0.396966	0.6917
DAY=20	2.897843	4.740988	0.611232	0.5415
DAY=21	1.264640	4.729530	0.267392	0.7893
DAY=22	-0.176874	4.734459	-0.037359	0.9702
DAY=23	-2.325610	4.739839	-0.490652	0.6240
DAY=24	-1.254281	4.727906	-0.265293	0.7910
DAY=25	-2.272538	4.712711	-0.482215	0.6300
DAY=26	-4.324668	4.717922	-0.916647	0.3600
DAY=27	-3.163231	4.719633	-0.670228	0.5032
DAY=28	-0.181453	4.720638	-0.038438	0.9694
DAY=29	-2.373164	4.824412	-0.491907	0.6231
DAY=30	-1.797419	4.833505	-0.371867	0.7102
DAY=31	-2.562911	5.537768	-0.462806	0.6438
MONTH="Aug"	21.59190	3.462419	6.236075	0.0000
MONTH="Dec"	12.63128	3.232623	3.907440	0.0001
MONTH="Feb"	-8.157780	3.551529	-2.296977	0.0223
MONTH="Jan"	-3.311985	3.222416	-1.027795	0.3048
MONTH="July"	2.252073	3.953001	0.569712	0.5693
MONTH="June"	1.888716	3.112112	0.606892	0.5444
MONTH="Mar"	-7.581435	3.072646	-2.467396	0.0141
MONTH="May"	8.213682	2.974805	2.761083	0.0061
MONTH="Nov"	12.18280	2.993391	4.069900	0.0001
MONTH="Oct"	11.24625	3.038368	3.701412	0.0003
MONTH="Sept"	11.32011	3.440742	3.290021	0.0011

R-squared	0.579161	Mean dependent var	69.48624
Adjusted R-squared	0.524269	S.D. dependent var	16.73624
S.E. of regression	11.54353	Akaike info criterion	7.840398
Sum squared resid	42907.49	Schwarz criterion	8.299838
Log likelihood	-1387.873	Hannan-Quinn criter.	8.022985
F-statistic	10.55091	Durbin-Watson stat	0.870606
Prob(F-statistic)	0.000000		

Dependent Variable: PRICE
Method: ARMA Conditional Least Squares (Gauss-Newton / Marquardt steps)
Sample (adjusted): 2 365
Included observations: 364 after adjustments
Convergence achieved after 7 iterations
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-8.630692	10.32305	-0.836060	0.4037
LOAD	0.034049	0.004991	6.822545	0.0000
DAY=2	1.431875	3.461524	0.413654	0.6794
DAY=3	0.934947	3.236696	0.288858	0.7729
DAY=4	5.216133	4.120487	1.265902	0.2065
DAY=5	10.42607	5.297128	1.968249	0.0499
DAY=6	6.405286	4.873956	1.314186	0.1897
DAY=7	1.443891	4.704740	0.306901	0.7591
DAY=8	3.118435	5.323021	0.585839	0.5584
DAY=9	5.984529	5.075710	1.179053	0.2393
DAY=10	5.642683	4.678288	1.206143	0.2287
DAY=11	5.052907	4.199093	1.203333	0.2297
DAY=12	4.636152	4.414016	1.050325	0.2944
DAY=13	0.289211	4.618819	0.062616	0.9501
DAY=14	0.454377	4.086106	0.111200	0.9115
DAY=15	-0.950129	4.727248	-0.200990	0.8408
DAY=16	3.954051	5.058983	0.781590	0.4350
DAY=17	0.188532	4.894958	0.038516	0.9693
DAY=18	-0.638685	4.411971	-0.144762	0.8850
DAY=19	3.224222	5.252059	0.613897	0.5397
DAY=20	4.158374	4.385600	0.948188	0.3437
DAY=21	2.240795	4.680790	0.478721	0.6325
DAY=22	0.910739	4.513364	0.201787	0.8402
DAY=23	-1.140722	4.043089	-0.282141	0.7780
DAY=24	-0.408915	4.515321	-0.090562	0.9279
DAY=25	-2.316712	4.212727	-0.549932	0.5827
DAY=26	-4.036023	5.452172	-0.740260	0.4597
DAY=27	-2.998176	5.407659	-0.554431	0.5797
DAY=28	-0.311566	4.470643	-0.069692	0.9445
DAY=29	-1.555842	3.860009	-0.403067	0.6872
DAY=30	-0.619202	3.246296	-0.190741	0.8488
DAY=31	0.555825	3.660873	0.151829	0.8794
MONTH="Aug"	25.32728	5.904700	4.289342	0.0000
MONTH="Dec"	15.19101	6.481378	2.343793	0.0197
MONTH="Feb"	-7.183742	7.067248	-1.016484	0.3102
MONTH="Jan"	2.947437	6.726908	0.438156	0.6616
MONTH="July"	8.546354	5.311596	1.608999	0.1086
MONTH="June"	3.953791	4.587702	0.861824	0.3894
MONTH="Mar"	-4.300823	5.311940	-0.809652	0.4187
MONTH="May"	7.337310	4.988159	1.470946	0.1423
MONTH="Nov"	12.73630	4.280142	2.975671	0.0031
MONTH="Oct"	13.57655	4.953869	2.740594	0.0065
MONTH="Sept"	14.16210	5.970451	2.372032	0.0183
AR(1)	0.599272	0.061312	9.774137	0.0000

R-squared	0.718839	Mean dependent var	69.55281
Adjusted R-squared	0.681058	S.D. dependent var	16.71082
S.E. of regression	9.437431	Akaike info criterion	7.440170
Sum squared resid	28500.83	Schwarz criterion	7.911255
Log likelihood	-1310.111	Hannan-Quinn criter.	7.627405
F-statistic	19.02646	Durbin-Watson stat	1.904969
Prob(F-statistic)	0.000000		

MODEL 2

Dependent Variable: PRICE
Method: Least Squares
Sample: 1 365
Included observations: 365
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-5.797085	8.904194	-0.651051	0.5155
LOAD	0.042379	0.004997	8.480707	0.0000
RES	-0.024601	0.002194	-11.21409	0.0000
DAY=2	1.758529	4.615922	0.380970	0.7035
DAY=3	-0.327304	4.180609	-0.078291	0.9376
DAY=4	4.179632	4.152961	1.006422	0.3150
DAY=5	8.287929	5.948261	1.393336	0.1645
DAY=6	4.701437	5.336787	0.880949	0.3790
DAY=7	1.412108	4.509255	0.313158	0.7544
DAY=8	2.005589	5.058243	0.396499	0.6920
DAY=9	1.462273	4.081319	0.358284	0.7204
DAY=10	3.533145	4.283754	0.824778	0.4101
DAY=11	2.855055	3.984384	0.716561	0.4742
DAY=12	-0.911624	4.135792	-0.220423	0.8257
DAY=13	-2.702111	4.660024	-0.579849	0.5624
DAY=14	-1.887120	4.433364	-0.425663	0.6706
DAY=15	-2.870735	4.745238	-0.604972	0.5456
DAY=16	1.868452	4.537296	0.411799	0.6808
DAY=17	-0.742338	4.192059	-0.177082	0.8596
DAY=18	-2.821872	4.052678	-0.696298	0.4867
DAY=19	-1.602112	4.640551	-0.345242	0.7301
DAY=20	-1.076296	4.149075	-0.259406	0.7955
DAY=21	-2.483141	4.255008	-0.583581	0.5599
DAY=22	-3.465370	3.911111	-0.886032	0.3763
DAY=23	-2.187564	3.901311	-0.560725	0.5754
DAY=24	-1.657537	4.498355	-0.368476	0.7128
DAY=25	-4.284693	4.351521	-0.984643	0.3255
DAY=26	-3.329566	5.260928	-0.632886	0.5273
DAY=27	-1.057925	5.582403	-0.189511	0.8498
DAY=28	-0.910102	4.743379	-0.191868	0.8480
DAY=29	-3.618801	4.592391	-0.787999	0.4313
DAY=30	-4.127481	3.838418	-1.075308	0.2830
DAY=31	-2.527653	4.346244	-0.581572	0.5613
MONTH="Aug"	18.65855	3.173581	5.879335	0.0000
MONTH="Dec"	14.91103	2.481816	6.008112	0.0000
MONTH="Feb"	-3.152363	2.906839	-1.084464	0.2790
MONTH="Jan"	1.104440	2.160909	0.511100	0.6096
MONTH="July"	4.350954	3.181118	1.367744	0.1723
MONTH="June"	2.252969	1.858453	1.212282	0.2263
MONTH="Mar"	-1.356449	2.227460	-0.608967	0.5430
MONTH="May"	6.308285	2.387325	2.642407	0.0086
MONTH="Nov"	12.48262	1.971010	6.333108	0.0000
MONTH="Oct"	10.83666	1.884233	5.751234	0.0000
MONTH="Sept"	9.024191	3.552312	2.540371	0.0115

R-squared	0.706939	Mean dependent var	69.48624
Adjusted R-squared	0.667682	S.D. dependent var	16.73624
S.E. of regression	9.647943	Akaike info criterion	7.484006
Sum squared resid	29879.58	Schwarz criterion	7.954131
Log likelihood	-1321.831	Hannan-Quinn criter.	7.670840
F-statistic	18.00783	Durbin-Watson stat	0.880726
Prob(F-statistic)	0.000000	Wald F-statistic	23.65423
Prob(Wald F-statistic)	0.000000		

Dependent Variable: PRICE
Method: ARMA Conditional Least Squares (Gauss-Newton / Marquardt steps)
Sample (adjusted): 2 365
Included observations: 364 after adjustments
Convergence achieved after 7 iterations
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.076681	8.910721	0.569727	0.5693
LOAD	0.035371	0.004320	8.187675	0.0000
RES	-0.022301	0.002266	-9.840953	0.0000
DAY=2	1.799652	2.426020	0.741813	0.4587
DAY=3	0.210889	2.960393	0.071237	0.9433
DAY=4	4.472791	3.560431	1.256250	0.2099
DAY=5	8.822778	4.907056	1.797978	0.0731
DAY=6	5.050411	4.390860	1.150210	0.2509
DAY=7	1.723244	4.730586	0.364277	0.7159
DAY=8	2.195746	4.749991	0.462263	0.6442
DAY=9	2.424626	4.406214	0.550274	0.5825
DAY=10	4.198387	4.305682	0.975081	0.3303
DAY=11	3.315088	4.039915	0.820584	0.4125
DAY=12	0.132883	4.073233	0.032623	0.9740
DAY=13	-1.917040	4.094822	-0.468162	0.6400
DAY=14	-1.315429	3.922318	-0.335370	0.7376
DAY=15	-2.621143	4.083502	-0.641886	0.5214
DAY=16	2.266869	4.059593	0.558398	0.5770
DAY=17	-0.421725	4.081966	-0.103314	0.9178
DAY=18	-2.376641	4.393531	-0.540941	0.5889
DAY=19	-0.688622	4.657432	-0.147854	0.8826
DAY=20	-0.170217	4.059538	-0.041930	0.9666
DAY=21	-1.778002	4.268998	-0.416492	0.6773
DAY=22	-2.748548	4.188826	-0.656162	0.5122
DAY=23	-1.753927	3.926750	-0.446661	0.6554
DAY=24	-1.415713	4.289288	-0.330058	0.7416
DAY=25	-4.493405	4.387713	-1.024088	0.3066
DAY=26	-3.723399	5.409187	-0.688347	0.4917
DAY=27	-1.808898	4.763043	-0.379778	0.7044
DAY=28	-1.876928	4.410015	-0.425606	0.6707
DAY=29	-3.307051	3.811141	-0.867732	0.3862
DAY=30	-2.892021	3.002441	-0.963223	0.3362
DAY=31	-0.359938	3.053028	-0.117895	0.9062
MONTH="Aug"	21.16828	5.456222	3.879658	0.0001
MONTH="Dec"	15.68491	5.082588	3.086008	0.0022
MONTH="Feb"	-4.350252	5.864484	-0.741796	0.4588
MONTH="Jan"	4.008942	4.997991	0.802111	0.4231
MONTH="July"	8.100350	4.763767	1.700409	0.0900
MONTH="June"	3.165170	4.064398	0.778755	0.4367
MONTH="Mar"	1.843502	5.188774	0.355287	0.7226
MONTH="May"	5.341540	4.509937	1.184393	0.2371
MONTH="Nov"	12.81728	3.891751	3.293449	0.0011
MONTH="Oct"	12.42255	4.016602	3.092801	0.0022
MONTH="Sept"	10.88710	5.098136	2.135505	0.0335
AR(1)	0.594450	0.062145	9.565561	0.0000

R-squared	0.801916	Mean dependent var	69.55281
Adjusted R-squared	0.774594	S.D. dependent var	16.71082
S.E. of regression	7.933797	Akaike info criterion	7.095430
Sum squared resid	20079.50	Schwarz criterion	7.577221
Log likelihood	-1246.368	Hannan-Quinn criter.	7.286920
F-statistic	29.35055	Durbin-Watson stat	2.018877
Prob(F-statistic)	0.000000		

Inverted AR Roots	.59

MODEL 3

Dependent Variable: PRICE
Method: Least Squares
Sample: 1 365
Included observations: 365
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-10.16617	9.361680	-1.085935	0.2783
LOAD	0.042595	0.005013	8.496073	0.0000
SOLAR	-0.011812	0.006507	-1.815299	0.0704
WIND	-0.024596	0.002184	-11.26018	0.0000
DAY=2	1.966346	4.642284	0.423573	0.6722
DAY=3	-0.228388	4.276191	-0.053409	0.9574
DAY=4	4.008244	4.295079	0.933218	0.3514
DAY=5	7.993768	6.038137	1.323880	0.1865
DAY=6	4.325099	5.404539	0.800272	0.4241
DAY=7	0.804619	4.562612	0.176350	0.8601
DAY=8	1.433761	5.112540	0.280440	0.7793
DAY=9	1.312311	4.153174	0.315978	0.7522
DAY=10	3.167078	4.318502	0.733374	0.4639
DAY=11	2.151698	4.060734	0.529879	0.5966
DAY=12	-1.392731	4.213738	-0.330522	0.7412
DAY=13	-2.840025	4.754694	-0.597310	0.5507
DAY=14	-1.708564	4.555132	-0.375086	0.7078
DAY=15	-3.067389	4.784715	-0.641081	0.5219
DAY=16	1.271121	4.564454	0.278483	0.7808
DAY=17	-0.854814	4.200392	-0.203508	0.8389
DAY=18	-2.784804	4.071309	-0.684007	0.4945
DAY=19	-1.940697	4.676466	-0.414992	0.6784
DAY=20	-0.915051	4.174839	-0.219182	0.8266
DAY=21	-2.743675	4.282233	-0.640711	0.5222
DAY=22	-3.634865	3.904715	-0.930891	0.3526
DAY=23	-2.373005	3.989688	-0.594785	0.5524
DAY=24	-2.212585	4.467323	-0.495282	0.6207
DAY=25	-4.261325	4.363506	-0.976583	0.3295
DAY=26	-3.659225	5.279299	-0.693127	0.4887
DAY=27	-1.623574	5.617002	-0.289046	0.7727
DAY=28	-0.952287	4.786319	-0.198960	0.8424
DAY=29	-4.041208	4.637419	-0.871435	0.3842
DAY=30	-4.863929	3.923897	-1.239566	0.2160
DAY=31	-2.852682	4.349498	-0.655865	0.5124
MONTH="Aug"	18.47870	3.203443	5.768385	0.0000
MONTH="Dec"	16.08368	2.497730	6.439321	0.0000
MONTH="Feb"	-1.752106	2.989882	-0.586012	0.5583
MONTH="Jan"	2.369649	2.213565	1.070513	0.2852
MONTH="July"	3.234014	3.270153	0.988949	0.3234
MONTH="June"	1.859195	1.883377	0.987160	0.3243
MONTH="Mar"	-0.819838	2.235060	-0.366808	0.7140
MONTH="May"	6.147980	2.430828	2.529171	0.0119
MONTH="Nov"	13.70508	2.110381	6.494126	0.0000
MONTH="Oct"	12.00798	1.852319	6.482672	0.0000
MONTH="Sept"	8.808709	3.561627	2.473226	0.0139

R-squared	0.709915	Mean dependent var	69.48624
Adjusted R-squared	0.670028	S.D. dependent var	16.73624
S.E. of regression	9.613833	Akaike info criterion	7.479282
Sum squared resid	29576.25	Schwarz criterion	7.960091
Log likelihood	-1319.969	Hannan-Quinn criter.	7.670362
F-statistic	17.79826	Durbin-Watson stat	0.858886
Prob(F-statistic)	0.000000	Wald F-statistic	22.87968
Prob(Wald F-statistic)	0.000000		

Dependent Variable: PRICE
Method: ARMA Conditional Least Squares (Gauss-Newton / Marquardt steps)
Sample (adjusted): 2 365
Included observations: 364 after adjustments
Convergence achieved after 7 iterations
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.917065	9.339946	-0.098187	0.9218
LOAD	0.035883	0.004358	8.234209	0.0000
SOLAR	-0.005743	0.005598	-1.025863	0.3057
WIND	-0.022609	0.002265	-9.983473	0.0000
DAY=2	2.125454	2.395377	0.887315	0.3756
DAY=3	0.394801	2.896794	0.136289	0.8917
DAY=4	4.324341	3.639801	1.188071	0.2357
DAY=5	8.505640	4.936616	1.722970	0.0859
DAY=6	4.639141	4.344893	1.067723	0.2865
DAY=7	1.029532	4.721197	0.218066	0.8275
DAY=8	1.541664	4.794493	0.321549	0.7480
DAY=9	2.276001	4.554195	0.499759	0.6176
DAY=10	3.797527	4.313249	0.880433	0.3793
DAY=11	2.472663	4.040715	0.611937	0.5410
DAY=12	-0.464129	4.119018	-0.112680	0.9104
DAY=13	-2.028175	4.146590	-0.489119	0.6251
DAY=14	-0.997791	3.927770	-0.254035	0.7996
DAY=15	-2.787741	4.146699	-0.672280	0.5019
DAY=16	1.566766	4.021361	0.389611	0.6971
DAY=17	-0.468329	3.999411	-0.117099	0.9069
DAY=18	-2.242575	4.237298	-0.529246	0.5970
DAY=19	-1.088945	4.652598	-0.234051	0.8151
DAY=20	0.083421	4.039719	0.020650	0.9835
DAY=21	-2.073013	4.185345	-0.495303	0.6207
DAY=22	-2.922314	4.118897	-0.709489	0.4785
DAY=23	-1.910244	3.917878	-0.487571	0.6262
DAY=24	-2.062815	4.173982	-0.494208	0.6215
DAY=25	-4.382553	4.305137	-1.017982	0.3095
DAY=26	-4.052599	5.290100	-0.766072	0.4442
DAY=27	-2.436029	4.690211	-0.519386	0.6039
DAY=28	-1.840559	4.329687	-0.425102	0.6710
DAY=29	-3.647356	3.791650	-0.961944	0.3368
DAY=30	-3.690470	2.991046	-1.233839	0.2182
DAY=31	-0.591623	3.060352	-0.193319	0.8468
MONTH="Aug"	20.67686	5.581516	3.704524	0.0002
MONTH="Dec"	17.33336	5.094774	3.402185	0.0008
MONTH="Feb"	-2.393619	5.916393	-0.404574	0.6861
MONTH="Jan"	5.331715	4.844717	1.100522	0.2719
MONTH="July"	6.476256	4.818126	1.344144	0.1799
MONTH="June"	2.654648	4.154245	0.639021	0.5233
MONTH="Mar"	2.595798	5.360286	0.484265	0.6285
MONTH="May"	4.894484	4.620422	1.059315	0.2903
MONTH="Nov"	14.11200	3.967665	3.556752	0.0004
MONTH="Oct"	13.86480	3.963376	3.498229	0.0005
MONTH="Sept"	10.41553	5.166199	2.016091	0.0446
AR(1)	0.604353	0.060883	9.926433	0.0000

R-squared	0.807693	Mean dependent var	69.55281
Adjusted R-squared	0.780479	S.D. dependent var	16.71082
S.E. of regression	7.829529	Akaike info criterion	7.071327
Sum squared resid	19493.88	Schwarz criterion	7.563824
Log likelihood	-1240.981	Hannan-Quinn criter.	7.267072
F-statistic	29.68006	Durbin-Watson stat	2.014426
Prob(F-statistic)	0.000000		

Inverted AR Roots	.60

MODEL 4

Dependent Variable: PRICE
Method: Least Squares
Sample: 1 365
Included observations: 364
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-27.75378	8.900019	-3.118396	0.0020
LOAD	0.036242	0.004519	8.019681	0.0000
SOLAR	-0.010903	0.006109	-1.784793	0.0752
WIND	-0.024748	0.001985	-12.47019	0.0000
GAS_PRICE	1.244905	0.153669	8.101198	0.0000
DAY=2	1.244138	2.738865	0.454253	0.6500
DAY=3	1.139091	2.906470	0.391916	0.6954
DAY=4	6.230269	3.190691	1.952639	0.0517
DAY=5	9.384350	5.238850	1.791300	0.0742
DAY=6	6.646689	4.465162	1.488566	0.1376
DAY=7	3.464346	3.307105	1.047546	0.2956
DAY=8	3.750352	3.956782	0.947829	0.3439
DAY=9	4.174563	2.833787	1.473139	0.1417
DAY=10	5.746799	3.116399	1.844051	0.0661
DAY=11	4.358189	2.714999	1.605227	0.1094
DAY=12	1.004471	2.919411	0.344066	0.7310
DAY=13	-0.666811	3.576869	-0.186423	0.8522
DAY=14	0.206424	3.415102	0.060445	0.9518
DAY=15	-1.408165	3.637588	-0.387115	0.6989
DAY=16	2.877718	3.527310	0.815839	0.4152
DAY=17	0.861824	3.075448	0.280227	0.7795
DAY=18	-1.060605	2.716585	-0.390418	0.6965
DAY=19	-0.395870	3.506398	-0.112899	0.9102
DAY=20	0.797570	2.954107	0.269987	0.7873
DAY=21	-1.360612	3.101692	-0.438668	0.6612
DAY=22	-2.430039	2.544363	-0.955068	0.3403
DAY=23	-0.979546	2.481864	-0.394681	0.6933
DAY=24	-0.639933	3.232267	-0.197983	0.8432
DAY=25	-3.263429	3.367448	-0.969110	0.3332
DAY=26	-4.402974	3.931945	-1.119796	0.2636
DAY=27	-1.524614	4.108521	-0.371086	0.7108
DAY=28	-0.343309	3.846843	-0.089244	0.9289
DAY=29	-2.121282	3.556267	-0.596491	0.5513
DAY=30	-2.965329	2.699011	-1.098673	0.2727
DAY=31	-0.618877	2.997106	-0.206491	0.8365
MONTH="Aug"	16.38546	3.167499	5.172997	0.0000
MONTH="Dec"	13.56173	2.392065	5.669468	0.0000
MONTH="Feb"	-0.391885	2.416671	-0.162159	0.8713
MONTH="Jan"	6.541885	2.172738	3.010894	0.0028
MONTH="July"	3.304675	3.038946	1.087441	0.2777
MONTH="June"	0.475047	1.850950	0.256650	0.7976
MONTH="Mar"	-1.663575	1.750998	-0.950072	0.3428
MONTH="May"	4.633333	2.484436	1.864944	0.0631
MONTH="Nov"	10.38987	2.114147	4.914450	0.0000
MONTH="Oct"	6.322262	1.897568	3.331770	0.0010
MONTH="Sept"	1.922031	3.613565	0.531893	0.5952

R-squared	0.750258	Mean dependent var	69.53126
Adjusted R-squared	0.714918	S.D. dependent var	16.73714
S.E. of regression	8.936478	Akaike info criterion	7.335805
Sum squared resid	25395.68	Schwarz criterion	7.828302
Log likelihood	-1289.117	Hannan-Quinn criter.	7.531550
F-statistic	21.22925	Durbin-Watson stat	0.931888
Prob(F-statistic)	0.000000	Wald F-statistic	30.96473
Prob(Wald F-statistic)	0.000000		

Dependent Variable: PRICE
Method: ARMA Conditional Least Squares (Gauss-Newton / Marquardt steps)
Sample (adjusted): 2 365
Included observations: 362 after adjustments
Convergence achieved after 7 iterations
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-18.04358	9.487786	-1.901769	0.0581
LOAD	0.031573	0.004312	7.321562	0.0000
SOLAR	-0.008169	0.005455	-1.497535	0.1353
WIND	-0.023102	0.002170	-10.64726	0.0000
GAS_PRICE	1.130521	0.250644	4.510463	0.0000
DAY=2	1.254340	2.475417	0.506719	0.6127
DAY=3	1.530794	2.857215	0.535765	0.5925
DAY=4	6.362875	3.390822	1.876499	0.0615
DAY=5	9.596164	4.612597	2.080425	0.0383
DAY=6	6.535395	3.729498	1.752352	0.0807
DAY=7	3.228898	4.064735	0.794369	0.4276
DAY=8	3.425148	4.131103	0.829112	0.4077
DAY=9	4.392606	3.839746	1.143984	0.2535
DAY=10	5.747899	3.593679	1.599447	0.1107
DAY=11	4.201660	3.289759	1.277194	0.2025
DAY=12	1.276258	3.422563	0.372895	0.7095
DAY=13	-0.529044	3.472709	-0.152343	0.8790
DAY=14	0.237859	3.251976	0.073143	0.9417
DAY=15	-1.630366	3.430828	-0.475211	0.6350
DAY=16	2.735477	3.340539	0.818873	0.4135
DAY=17	0.701331	3.341660	0.209875	0.8339
DAY=18	-1.117942	3.562298	-0.313826	0.7539
DAY=19	-0.126617	4.021938	-0.031481	0.9749
DAY=20	1.093561	3.343574	0.327063	0.7438
DAY=21	-1.218189	3.559862	-0.342201	0.7324
DAY=22	-2.244081	3.361758	-0.667532	0.5049
DAY=23	-0.998957	3.039697	-0.328637	0.7426
DAY=24	-0.836131	3.449744	-0.242375	0.8086
DAY=25	-3.666863	3.696529	-0.991975	0.3220
DAY=26	-4.760610	4.334648	-1.098269	0.2729
DAY=27	-2.177757	3.769687	-0.577702	0.5639
DAY=28	-1.071371	3.379221	-0.317047	0.7514
DAY=29	-2.744061	3.095028	-0.886603	0.3760
DAY=30	-2.911917	2.515090	-1.157778	0.2478
DAY=31	-0.186229	2.779135	-0.067010	0.9466
MONTH="Aug"	18.08303	5.341053	3.385667	0.0008
MONTH="Dec"	14.65069	4.831878	3.032091	0.0026
MONTH="Feb"	-0.791863	4.882984	-0.162168	0.8713
MONTH="Jan"	8.169302	4.580051	1.783671	0.0754
MONTH="July"	5.793994	4.604767	1.258260	0.2092
MONTH="June"	1.364906	3.961523	0.344541	0.7307
MONTH="Mar"	0.853397	4.543186	0.187841	0.8511
MONTH="May"	3.932406	4.275925	0.919662	0.3585
MONTH="Nov"	10.67700	3.882065	2.750340	0.0063
MONTH="Oct"	8.150859	3.958104	2.059284	0.0403
MONTH="Sept"	4.390406	5.251462	0.836035	0.4038
AR(1)	0.557734	0.066261	8.417188	0.0000

R-squared	0.822835	Mean dependent var	69.62217
Adjusted R-squared	0.796964	S.D. dependent var	16.72832
S.E. of regression	7.537706	Akaike info criterion	6.998310
Sum squared resid	17897.36	Schwarz criterion	7.503579
Log likelihood	-1219.694	Hannan-Quinn criter.	7.199173
F-statistic	31.80448	Durbin-Watson stat	2.004504
Prob(F-statistic)	0.000000		

TEST ON THE RESIDUALS

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.137499	Prob. F(2,313)	0.8716
Obs*R-squared	0.317769	Prob. Chi-Square(2)	0.8531

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Sample: 2 365
Included observations: 362
Coefficient covariance computed using outer product of gradients
Presample and interior missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.091737	8.740983	-0.010495	0.9916
LOAD	5.43E-06	0.004051	0.001341	0.9989
SOLAR	-9.76E-05	0.005587	-0.017465	0.9861
WIND	2.59E-05	0.001869	0.013857	0.9890
GAS_PRICE	-0.001095	0.212844	-0.005142	0.9959
DAY=2	0.099124	2.499343	0.039660	0.9684
DAY=3	0.055905	3.203425	0.017452	0.9861
DAY=4	0.126440	3.517436	0.035947	0.9713
DAY=5	0.105897	3.612201	0.029317	0.9766
DAY=6	0.099387	3.686137	0.026962	0.9785
DAY=7	0.099621	3.741638	0.026625	0.9788
DAY=8	0.103350	3.753005	0.027538	0.9780
DAY=9	0.104059	3.799738	0.027386	0.9782
DAY=10	0.105980	3.791734	0.027950	0.9777
DAY=11	0.111485	3.789340	0.029421	0.9765
DAY=12	0.113270	3.819256	0.029658	0.9764
DAY=13	0.108220	3.796192	0.028508	0.9773
DAY=14	0.105442	3.783329	0.027870	0.9778
DAY=15	0.109593	3.770899	0.029063	0.9768
DAY=16	0.113608	3.781904	0.030040	0.9761
DAY=17	0.107720	3.773721	0.028545	0.9772
DAY=18	0.107663	3.775977	0.028513	0.9773
DAY=19	0.113883	3.799690	0.029972	0.9761
DAY=20	0.109524	3.797856	0.028838	0.9770
DAY=21	0.113685	3.784652	0.030038	0.9761
DAY=22	0.112694	3.778942	0.029822	0.9762
DAY=23	0.109430	3.764310	0.029070	0.9768
DAY=24	0.113903	3.751602	0.030361	0.9758
DAY=25	0.111432	3.710461	0.030032	0.9761
DAY=26	0.115103	3.666341	0.031394	0.9750
DAY=27	0.118761	3.585309	0.033124	0.9736
DAY=28	0.122178	3.421627	0.035708	0.9715
DAY=29	0.157868	3.342705	0.047228	0.9624
DAY=30	0.095131	2.995957	0.031753	0.9747
DAY=31	0.168004	3.093093	0.054316	0.9567
MONTH="Aug"	0.039252	4.394591	0.008932	0.9929
MONTH="Dec"	0.048515	4.345617	0.011164	0.9911
MONTH="Feb"	0.085323	4.502474	0.018950	0.9849
MONTH="Jan"	-0.089319	4.501867	-0.019841	0.9842
MONTH="July"	0.038292	4.554038	0.008408	0.9933
MONTH="June"	0.065358	4.214647	0.015507	0.9876
MONTH="Mar"	-0.013557	4.070267	-0.003331	0.9973
MONTH="May"	-0.000711	3.984727	-0.000178	0.9999
MONTH="Nov"	-0.041570	4.220872	-0.009849	0.9921
MONTH="Oct"	-0.019812	4.337039	-0.004568	0.9964
MONTH="Sept"	0.085099	4.457350	0.019092	0.9848
AR(1)	-0.038575	0.154392	-0.249852	0.8029
RESID(-1)	0.030021	0.165304	0.181613	0.8560
RESID(-2)	0.046885	0.104096	0.450397	0.6527

R-squared	0.000878	Mean dependent var	1.42E-11
Adjusted R-squared	-0.152342	S.D. dependent var	7.041106
S.E. of regression	7.558431	Akaike info criterion	7.008481
Sum squared resid	17881.65	Schwarz criterion	7.535251
Log likelihood	-1219.535	Hannan-Quinn criter.	7.217891
F-statistic	0.005729	Durbin-Watson stat	1.991088
Prob(F-statistic)	1.000000		

SARDINIA

MODEL 1

Dependent Variable: PRICE
Method: Least Squares
Sample: 1 365
Included observations: 365

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	13.81087	5.487684	2.516704	0.0123
LOAD	0.038557	0.005502	7.008270	0.0000
DAY=2	3.058671	2.969833	1.029913	0.3038
DAY=3	1.045485	2.968864	0.352150	0.7250
DAY=4	1.491509	2.968990	0.502362	0.6158
DAY=5	1.182083	2.976911	0.397084	0.6916
DAY=6	0.739112	2.974992	0.248442	0.8040
DAY=7	0.662672	2.965586	0.223454	0.8233
DAY=8	-1.730484	2.964976	-0.583642	0.5599
DAY=9	-0.390471	2.970384	-0.131455	0.8955
DAY=10	0.607107	2.974263	0.204120	0.8384
DAY=11	0.301662	2.971353	0.101524	0.9192
DAY=12	0.150211	2.971070	0.050558	0.9597
DAY=13	0.120749	2.972826	0.040618	0.9676
DAY=14	-0.493657	2.971815	-0.166113	0.8682
DAY=15	-0.363678	2.971383	-0.122393	0.9027
DAY=16	1.324474	2.965017	0.446700	0.6554
DAY=17	0.208777	2.967806	0.070347	0.9440
DAY=18	0.720780	2.965476	0.243057	0.8081
DAY=19	4.707958	2.965368	1.587647	0.1133
DAY=20	2.958220	2.973629	0.994818	0.3206
DAY=21	3.495670	2.982359	1.172116	0.2420
DAY=22	4.032774	2.968848	1.358363	0.1753
DAY=23	3.100959	2.968015	1.044792	0.2969
DAY=24	3.129603	2.965931	1.055184	0.2921
DAY=25	-0.136972	2.965452	-0.046189	0.9632
DAY=26	3.947544	2.972273	1.328123	0.1851
DAY=27	4.287967	2.974650	1.441503	0.1504
DAY=28	2.490239	2.966581	0.839431	0.4019
DAY=29	-0.829806	3.036161	-0.273308	0.7848
DAY=30	0.359670	3.045148	0.118112	0.9061
DAY=31	-0.360901	3.482374	-0.103637	0.9175
MONTH="Aug"	7.206574	2.248883	3.204512	0.0015
MONTH="Dec"	9.808023	1.933405	5.072926	0.0000
MONTH="Feb"	-0.188225	2.086860	-0.090196	0.9282
MONTH="Jan"	-6.279397	1.910025	-3.287599	0.0011
MONTH="July"	5.580537	2.063510	2.704390	0.0072
MONTH="June"	6.116335	1.887810	3.239910	0.0013
MONTH="Mar"	3.682641	1.873793	1.965341	0.0502
MONTH="May"	2.759762	1.864620	1.480067	0.1398
MONTH="Nov"	13.61609	1.891448	7.198764	0.0000
MONTH="Oct"	20.54548	1.863151	11.02728	0.0000
MONTH="Sept"	20.16445	1.994484	10.11011	0.0000

R-squared	0.622459	Mean dependent var	60.69124
Adjusted R-squared	0.573215	S.D. dependent var	11.11699

S.E. of regression	7.262599	Akaike info criterion	6.913623
Sum squared resid	16984.00	Schwarz criterion	7.373063
Log likelihood	-1218.736	Hannan-Quinn criter.	7.096211
F-statistic	12.64019	Durbin-Watson stat	0.992556
Prob(F-statistic)	0.000000		

Dependent Variable: PRICE
Method: ARMA Conditional Least Squares (Gauss-Newton / Marquardt steps)
Sample (adjusted): 2 365
Included observations: 364 after adjustments
Convergence achieved after 7 iterations
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	22.09485	7.471728	2.957127	0.0033
LOAD	0.028559	0.006899	4.139511	0.0000
DAY=2	3.769091	2.879625	1.308883	0.1915
DAY=3	1.937312	2.850904	0.679543	0.4973
DAY=4	2.501798	3.598863	0.695164	0.4875
DAY=5	2.456150	3.694408	0.664829	0.5066
DAY=6	2.004993	3.708004	0.540720	0.5891
DAY=7	1.614090	3.434394	0.469978	0.6387
DAY=8	-0.907032	3.444366	-0.263338	0.7925
DAY=9	0.789441	3.569400	0.221169	0.8251
DAY=10	1.890618	3.722031	0.507953	0.6118
DAY=11	1.513489	3.796439	0.398660	0.6904
DAY=12	1.354848	3.795843	0.356929	0.7214
DAY=13	1.372329	3.646456	0.376346	0.7069
DAY=14	0.731955	3.491444	0.209643	0.8341
DAY=15	0.850172	3.475379	0.244627	0.8069
DAY=16	2.220627	3.371816	0.658585	0.5106
DAY=17	1.303478	4.171587	0.312466	0.7549
DAY=18	1.679872	3.711110	0.452660	0.6511
DAY=19	5.472054	3.650222	1.499102	0.1348
DAY=20	4.222861	3.436551	1.228808	0.2200
DAY=21	4.926247	3.878372	1.270184	0.2049
DAY=22	5.143547	3.801020	1.353202	0.1769
DAY=23	4.158727	3.854623	1.078893	0.2814
DAY=24	4.040359	3.660504	1.103771	0.2705
DAY=25	0.458491	3.816765	0.120125	0.9045
DAY=26	4.878497	4.424415	1.102631	0.2710
DAY=27	5.007244	4.509849	1.110291	0.2677
DAY=28	2.447867	4.091923	0.598219	0.5501
DAY=29	1.136791	3.381228	0.336206	0.7369
DAY=30	2.617163	2.958325	0.884677	0.3770
DAY=31	2.541570	3.291600	0.772138	0.4406
MONTH="Aug"	10.31495	3.536945	2.916345	0.0038
MONTH="Dec"	10.65817	3.665066	2.908043	0.0039
MONTH="Feb"	0.017826	4.555441	0.003913	0.9969
MONTH="Jan"	-5.375972	3.665066	-1.466815	0.1434
MONTH="July"	7.405536	3.434967	2.155926	0.0318
MONTH="June"	5.564748	3.447566	1.614109	0.1075
MONTH="Mar"	4.791701	4.405261	1.087722	0.2775
MONTH="May"	2.366752	3.446279	0.686756	0.4927
MONTH="Nov"	13.63906	3.256965	4.187660	0.0000
MONTH="Oct"	20.32547	3.206266	6.339296	0.0000
MONTH="Sept"	20.54027	3.917772	5.242844	0.0000
AR(1)	0.533313	0.080852	6.596141	0.0000

R-squared	0.721878	Mean dependent var	60.73685
Adjusted R-squared	0.684505	S.D. dependent var	11.09804
S.E. of regression	6.233649	Akaike info criterion	6.610726

Sum squared resid	12434.68	Schwarz criterion	7.081811
Log likelihood	-1159.152	Hannan-Quinn criter.	6.797961
F-statistic	19.31565	Durbin-Watson stat	2.102004
Prob(F-statistic)	0.000000		

Inverted AR Roots	.53

MODEL 2

Dependent Variable: PRICE
Method: Least Squares
Sample: 1 365
Included observations: 365
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	19.73434	7.700822	2.562628	0.0108
LOAD	0.034257	0.007328	4.674877	0.0000
RES	-0.005311	0.002952	-1.799269	0.0729
DAY=2	3.343385	5.164709	0.647352	0.5179
DAY=3	1.461088	4.256450	0.343264	0.7316
DAY=4	1.522278	4.477152	0.340010	0.7341
DAY=5	0.964172	4.235077	0.227663	0.8201
DAY=6	0.556196	4.246891	0.130965	0.8959
DAY=7	0.493076	4.128893	0.119421	0.9050
DAY=8	-1.839429	3.937786	-0.467122	0.6407
DAY=9	-0.495953	4.158959	-0.119249	0.9052
DAY=10	0.387571	4.237401	0.091464	0.9272
DAY=11	0.156220	4.353571	0.035883	0.9714
DAY=12	0.258308	4.253350	0.060730	0.9516
DAY=13	0.124781	4.146015	0.030097	0.9760
DAY=14	-0.419442	4.070748	-0.103038	0.9180
DAY=15	-0.531041	3.984784	-0.133267	0.8941
DAY=16	1.154336	4.045299	0.285353	0.7756
DAY=17	0.356777	4.713369	0.075695	0.9397
DAY=18	0.652546	3.925893	0.166216	0.8681
DAY=19	4.331989	4.163724	1.040412	0.2989
DAY=20	2.768489	4.185238	0.661489	0.5088
DAY=21	3.543684	4.448139	0.796667	0.4262
DAY=22	4.307383	4.175601	1.031560	0.3031
DAY=23	3.095334	4.307991	0.718510	0.4730
DAY=24	3.057177	4.164334	0.734134	0.4634
DAY=25	-0.259720	4.247911	-0.061141	0.9513
DAY=26	4.015608	4.798975	0.836764	0.4033
DAY=27	4.348684	5.570838	0.780616	0.4356
DAY=28	2.164660	4.799424	0.451025	0.6523
DAY=29	-1.139600	3.977895	-0.286483	0.7747
DAY=30	0.024070	4.123692	0.005837	0.9953
DAY=31	-0.294490	4.767042	-0.061776	0.9508
MONTH="Aug"	7.540646	2.087940	3.611524	0.0004
MONTH="Dec"	10.16193	1.915724	5.304485	0.0000
MONTH="Feb"	0.163361	2.562987	0.063739	0.9492
MONTH="Jan"	-5.581098	1.603661	-3.480223	0.0006
MONTH="July"	5.757434	1.752661	3.284967	0.0011
MONTH="June"	5.680469	1.624714	3.496288	0.0005
MONTH="Mar"	4.552747	2.283409	1.993838	0.0470
MONTH="May"	2.195226	1.611839	1.361939	0.1742
MONTH="Nov"	13.39081	1.626841	8.231176	0.0000
MONTH="Oct"	20.56614	1.493772	13.76793	0.0000
MONTH="Sept"	20.18778	1.994232	10.12308	0.0000

R-squared	0.627193	Mean dependent var	60.69124
Adjusted R-squared	0.577253	S.D. dependent var	11.11699
S.E. of regression	7.228156	Akaike info criterion	6.906485
Sum squared resid	16771.04	Schwarz criterion	7.376609

Log likelihood	-1216.433	Hannan-Quinn criter.	7.093318
F-statistic	12.55897	Durbin-Watson stat	0.989065
Prob(F-statistic)	0.000000	Wald F-statistic	23.66504
Prob(Wald F-statistic)	0.000000		

Dependent Variable: PRICE
Method: ARMA Conditional Least Squares (Gauss-Newton / Marquardt steps)
Sample (adjusted): 2 365
Included observations: 364 after adjustments
Convergence achieved after 7 iterations
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	26.41674	7.467281	3.537665	0.0005
LOAD	0.025745	0.006790	3.791916	0.0002
RES	-0.004877	0.002660	-1.833430	0.0677
DAY=2	4.073557	2.801768	1.453924	0.1470
DAY=3	2.406201	2.740548	0.878000	0.3806
DAY=4	2.637784	3.553038	0.742403	0.4584
DAY=5	2.351613	3.587995	0.655411	0.5127
DAY=6	1.942848	3.558432	0.545984	0.5855
DAY=7	1.604753	3.291218	0.487586	0.6262
DAY=8	-0.843586	3.275875	-0.257515	0.7969
DAY=9	0.816948	3.424377	0.238568	0.8116
DAY=10	1.802321	3.602265	0.500330	0.6172
DAY=11	1.501742	3.658959	0.410429	0.6818
DAY=12	1.576954	3.644985	0.432636	0.6656
DAY=13	1.493636	3.504712	0.426179	0.6703
DAY=14	0.920715	3.328511	0.276615	0.7823
DAY=15	0.818431	3.349317	0.244358	0.8071
DAY=16	2.222406	3.258735	0.681984	0.4957
DAY=17	1.574888	4.080346	0.385969	0.6998
DAY=18	1.768067	3.588795	0.492663	0.6226
DAY=19	5.299707	3.542592	1.495997	0.1356
DAY=20	4.164621	3.347189	1.244214	0.2143
DAY=21	5.067266	3.764971	1.345898	0.1793
DAY=22	5.528449	3.663247	1.509166	0.1322
DAY=23	4.291229	3.764084	1.140046	0.2551
DAY=24	4.126053	3.558110	1.159619	0.2471
DAY=25	0.529417	3.732124	0.141854	0.8873
DAY=26	5.077853	4.331901	1.172200	0.2420
DAY=27	5.206387	4.394181	1.184837	0.2370
DAY=28	2.343783	3.966171	0.590944	0.5550
DAY=29	1.041194	3.277775	0.317653	0.7510
DAY=30	2.435283	2.864195	0.850250	0.3958
DAY=31	2.601135	3.129426	0.831186	0.4065
MONTH="Aug"	10.24879	3.449656	2.970961	0.0032
MONTH="Dec"	10.76912	3.566496	3.019523	0.0027
MONTH="Feb"	0.306146	4.465218	0.068562	0.9454
MONTH="Jan"	-5.029320	3.480171	-1.445136	0.1494
MONTH="July"	7.279672	3.347389	2.174731	0.0304
MONTH="June"	5.090878	3.366625	1.512161	0.1315
MONTH="Mar"	5.403692	4.276866	1.263470	0.2073
MONTH="May"	1.762866	3.403071	0.518022	0.6048
MONTH="Nov"	13.28554	3.137671	4.234204	0.0000
MONTH="Oct"	20.45787	3.092304	6.615738	0.0000
MONTH="Sept"	20.34168	3.838306	5.299649	0.0000
AR(1)	0.530971	0.082692	6.421094	0.0000

R-squared	0.725391	Mean dependent var	60.73685
Adjusted R-squared	0.687514	S.D. dependent var	11.09804
S.E. of regression	6.203856	Akaike info criterion	6.603509

Sum squared resid	12277.62	Schwarz criterion	7.085300
Log likelihood	-1156.839	Hannan-Quinn criter.	6.794999
F-statistic	19.15115	Durbin-Watson stat	2.130310
Prob(F-statistic)	0.000000		
Inverted AR Roots	.53		

MODEL 3

Dependent Variable: PRICE
Method: Least Squares
Sample: 1 365
Included observations: 365
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	18.75457	9.679917	1.937472	0.0536
LOAD	0.034549	0.007739	4.464483	0.0000
SOLAR	-0.000746	0.016369	-0.045586	0.9637
WIND	-0.005373	0.002886	-1.861530	0.0636
DAY=2	3.307853	5.122383	0.645764	0.5189
DAY=3	1.509301	4.310670	0.350131	0.7265
DAY=4	1.589224	4.542325	0.349870	0.7267
DAY=5	0.968808	4.267837	0.227002	0.8206
DAY=6	0.529681	4.253991	0.124514	0.9010
DAY=7	0.549471	4.198488	0.130873	0.8960
DAY=8	-1.815639	3.976317	-0.456613	0.6483
DAY=9	-0.592383	4.131131	-0.143395	0.8861
DAY=10	0.412354	4.289090	0.096140	0.9235
DAY=11	0.132587	4.357107	0.030430	0.9757
DAY=12	0.197352	4.238401	0.046563	0.9629
DAY=13	0.102090	4.157510	0.024556	0.9804
DAY=14	-0.442311	4.086118	-0.108247	0.9139
DAY=15	-0.516079	4.018797	-0.128416	0.8979
DAY=16	1.165271	4.068459	0.286416	0.7747
DAY=17	0.317706	4.722095	0.067281	0.9464
DAY=18	0.622972	3.921834	0.158847	0.8739
DAY=19	4.332877	4.194490	1.032992	0.3024
DAY=20	2.739234	4.185669	0.654432	0.5133
DAY=21	3.511140	4.454333	0.788253	0.4311
DAY=22	4.246973	4.163346	1.020087	0.3085
DAY=23	2.977119	4.265969	0.697876	0.4858
DAY=24	2.935504	4.112387	0.713820	0.4759
DAY=25	-0.311920	4.219649	-0.073921	0.9411
DAY=26	3.901528	4.734134	0.824127	0.4105
DAY=27	4.249550	5.421809	0.783788	0.4337
DAY=28	2.131159	4.815435	0.442568	0.6584
DAY=29	-1.228940	3.938461	-0.312035	0.7552
DAY=30	-0.028882	4.106399	-0.007033	0.9944
DAY=31	-0.351976	4.744084	-0.074193	0.9409
MONTH="Aug"	7.517150	2.110309	3.562108	0.0004
MONTH="Dec"	10.48051	2.004394	5.228769	0.0000
MONTH="Feb"	0.419204	2.803850	0.149510	0.8812
MONTH="Jan"	-5.357585	1.662590	-3.222434	0.0014
MONTH="July"	5.752889	1.757110	3.274064	0.0012
MONTH="June"	5.756634	1.646001	3.497345	0.0005
MONTH="Mar"	4.730039	2.272559	2.081371	0.0382
MONTH="May"	2.396955	1.730361	1.385234	0.1669
MONTH="Nov"	13.63775	1.742236	7.827727	0.0000
MONTH="Oct"	20.68430	1.533797	13.48569	0.0000
MONTH="Sept"	20.19245	1.998269	10.10497	0.0000

R-squared	0.627363	Mean dependent var	60.69124
Adjusted R-squared	0.576125	S.D. dependent var	11.11699

S.E. of regression	7.237794	Akaike info criterion	6.911509
Sum squared resid	16763.41	Schwarz criterion	7.392318
Log likelihood	-1216.350	Hannan-Quinn criter.	7.102589
F-statistic	12.24418	Durbin-Watson stat	0.985112
Prob(F-statistic)	0.000000	Wald F-statistic	22.89000
Prob(Wald F-statistic)	0.000000		

Dependent Variable: PRICE
Method: ARMA Conditional Least Squares (Gauss-Newton / Marquardt steps)
Sample (adjusted): 2 365
Included observations: 364 after adjustments
Convergence achieved after 8 iterations
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	23.26089	8.537977	2.724403	0.0068
LOAD	0.026334	0.007023	3.749740	0.0002
SOLAR	0.010791	0.011842	0.911289	0.3628
WIND	-0.005276	0.002592	-2.035785	0.0426
DAY=2	3.996666	2.708078	1.475831	0.1410
DAY=3	2.642388	2.752846	0.959875	0.3378
DAY=4	2.937787	3.499390	0.839514	0.4018
DAY=5	2.439644	3.589423	0.679676	0.4972
DAY=6	1.927269	3.595448	0.536030	0.5923
DAY=7	1.871103	3.333605	0.561285	0.5750
DAY=8	-0.690567	3.298545	-0.209355	0.8343
DAY=9	0.563214	3.442157	0.163622	0.8701
DAY=10	1.968944	3.644587	0.540238	0.5894
DAY=11	1.501070	3.654230	0.410776	0.6815
DAY=12	1.455348	3.681879	0.395273	0.6929
DAY=13	1.502715	3.529611	0.425745	0.6706
DAY=14	0.930912	3.355746	0.277408	0.7816
DAY=15	0.951380	3.401251	0.279715	0.7799
DAY=16	2.332490	3.268901	0.713539	0.4760
DAY=17	1.527668	4.106135	0.372045	0.7101
DAY=18	1.742535	3.613309	0.482255	0.6300
DAY=19	5.363799	3.605709	1.487585	0.1379
DAY=20	4.143910	3.361816	1.232640	0.2186
DAY=21	5.047347	3.784865	1.333561	0.1833
DAY=22	5.409883	3.694907	1.464146	0.1441
DAY=23	3.959522	3.796987	1.042806	0.2978
DAY=24	3.774118	3.577177	1.055055	0.2922
DAY=25	0.405866	3.742327	0.108453	0.9137
DAY=26	4.752569	4.287291	1.108525	0.2685
DAY=27	4.925595	4.304873	1.144191	0.2534
DAY=28	2.260960	3.980033	0.568076	0.5704
DAY=29	0.824574	3.279313	0.251447	0.8016
DAY=30	2.345102	2.852135	0.822227	0.4116
DAY=31	2.586290	3.118747	0.829272	0.4076
MONTH="Aug"	10.44258	3.463758	3.014812	0.0028
MONTH="Dec"	12.01800	3.641110	3.300641	0.0011
MONTH="Feb"	1.347620	4.712139	0.285989	0.7751
MONTH="Jan"	-4.135072	3.568849	-1.158657	0.2475
MONTH="July"	7.481438	3.379110	2.214026	0.0275
MONTH="June"	5.452023	3.417952	1.595114	0.1117
MONTH="Mar"	6.293352	4.303358	1.462428	0.1446
MONTH="May"	2.623790	3.379844	0.776305	0.4381
MONTH="Nov"	14.24528	3.176392	4.484738	0.0000
MONTH="Oct"	21.04732	3.163818	6.652507	0.0000
MONTH="Sept"	20.47912	3.898497	5.253081	0.0000
AR(1)	0.538225	0.080889	6.653839	0.0000

R-squared	0.727437	Mean dependent var	60.73685

Adjusted R-squared	0.688867	S.D. dependent var	11.09804
S.E. of regression	6.190411	Akaike info criterion	6.601525
Sum squared resid	12186.14	Schwarz criterion	7.094022
Log likelihood	-1155.478	Hannan-Quinn criter.	6.797270
F-statistic	18.86004	Durbin-Watson stat	2.130868
Prob(F-statistic)	0.000000		

Inverted AR Roots	.54

MODEL 4

Dependent Variable: PRICE
Method: Least Squares
Sample: 1 365
Included observations: 364
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-6.299958	7.541546	-0.835367	0.4041
LOAD	0.018683	0.004841	3.859145	0.0001
SOLAR	-0.007600	0.008619	-0.881751	0.3786
WIND	-0.008035	0.001928	-4.167505	0.0000
GAS_PRICE	1.799953	0.208971	8.613426	0.0000
DAY=2	2.611926	2.781710	0.938964	0.3485
DAY=3	3.436567	2.489027	1.380687	0.1683
DAY=4	4.657706	2.937966	1.585351	0.1139
DAY=5	2.831102	2.208692	1.281800	0.2008
DAY=6	3.938529	2.403600	1.638596	0.1023
DAY=7	3.762271	2.363036	1.592134	0.1123
DAY=8	1.109162	2.279107	0.486665	0.6268
DAY=9	3.004319	2.455969	1.223272	0.2221
DAY=10	3.676975	2.407978	1.526997	0.1278
DAY=11	3.199706	2.554486	1.252583	0.2113
DAY=12	3.291305	2.525186	1.303391	0.1934
DAY=13	2.812514	2.598373	1.082413	0.2799
DAY=14	2.078862	2.451941	0.847843	0.3972
DAY=15	1.923385	2.180434	0.882111	0.3784
DAY=16	2.954601	2.363664	1.250009	0.2122
DAY=17	2.625292	3.130054	0.838737	0.4022
DAY=18	2.619782	2.260428	1.158976	0.2473
DAY=19	5.358750	2.370235	2.260851	0.0244
DAY=20	4.806382	2.625990	1.830312	0.0681
DAY=21	5.713166	2.807108	2.035250	0.0427
DAY=22	5.808544	2.668553	2.176664	0.0302
DAY=23	4.556741	2.630900	1.732008	0.0842
DAY=24	4.873222	2.432591	2.003305	0.0460
DAY=25	0.947093	2.788936	0.339589	0.7344
DAY=26	3.111322	2.637661	1.179576	0.2391
DAY=27	4.696690	2.661082	1.764955	0.0785
DAY=28	2.644966	2.501660	1.057284	0.2912
DAY=29	1.562397	2.366345	0.660257	0.5096
DAY=30	2.759751	2.366161	1.166341	0.2444
DAY=31	2.850535	2.842077	1.002976	0.3166
MONTH="Aug"	4.567501	1.612124	2.833219	0.0049
MONTH="Dec"	5.468735	1.604366	3.408657	0.0007
MONTH="Feb"	0.851387	1.618711	0.525966	0.5993
MONTH="Jan"	-0.645133	1.533369	-0.420729	0.6742
MONTH="July"	3.552002	1.450349	2.449067	0.0149
MONTH="June"	2.383510	1.497927	1.591206	0.1126
MONTH="Mar"	2.651158	1.387800	1.910332	0.0570
MONTH="May"	-0.603483	1.457700	-0.413996	0.6792
MONTH="Nov"	8.388029	1.558700	5.381427	0.0000
MONTH="Oct"	11.08831	1.662218	6.670795	0.0000
MONTH="Sept"	8.845804	2.102571	4.207138	0.0000

R-squared	0.821880	Mean dependent var	60.71209
Adjusted R-squared	0.796674	S.D. dependent var	11.12515
S.E. of regression	5.016511	Akaike info criterion	6.180991
Sum squared resid	8002.592	Schwarz criterion	6.673489
Log likelihood	-1078.940	Hannan-Quinn criter.	6.376736
F-statistic	32.60698	Durbin-Watson stat	1.721018
Prob(F-statistic)	0.000000	Wald F-statistic	34.97861
Prob(Wald F-statistic)	0.000000		

Dependent Variable: PRICE
Method: ARMA Conditional Least Squares (Gauss-Newton / Marquardt steps)
Sample (adjusted): 2 365
Included observations: 362 after adjustments
Convergence achieved after 5 iterations
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-6.756303	8.292969	-0.814703	0.4159
LOAD	0.018822	0.005263	3.576425	0.0004
SOLAR	-0.005368	0.009026	-0.594728	0.5525
WIND	-0.007886	0.002002	-3.939665	0.0001
GAS_PRICE	1.765454	0.230977	7.643414	0.0000
DAY=2	3.016467	2.609532	1.155942	0.2486
DAY=3	3.943370	2.479769	1.590217	0.1128
DAY=4	4.456182	2.969003	1.500902	0.1344
DAY=5	3.197476	2.241572	1.426444	0.1547
DAY=6	4.336515	2.429092	1.785241	0.0752
DAY=7	4.197248	2.356719	1.780971	0.0759
DAY=8	1.530219	2.319753	0.659648	0.5100
DAY=9	3.374370	2.477837	1.361821	0.1742
DAY=10	4.112519	2.464535	1.668680	0.0962
DAY=11	3.613481	2.589004	1.395703	0.1638
DAY=12	3.682158	2.576213	1.429291	0.1539
DAY=13	3.231546	2.590805	1.247314	0.2132
DAY=14	2.498776	2.409198	1.037181	0.3004
DAY=15	2.366442	2.236365	1.058165	0.2908
DAY=16	3.395991	2.381366	1.426069	0.1548
DAY=17	3.035451	3.135440	0.968110	0.3337
DAY=18	3.039795	2.316475	1.312250	0.1904
DAY=19	5.810192	2.404747	2.416134	0.0163
DAY=20	5.240212	2.573963	2.035854	0.0426
DAY=21	6.144164	2.806801	2.189027	0.0293
DAY=22	6.222357	2.666802	2.333266	0.0203
DAY=23	4.950528	2.641776	1.873939	0.0619
DAY=24	5.256035	2.455522	2.140496	0.0331
DAY=25	1.364707	2.830942	0.482068	0.6301
DAY=26	3.555071	2.621149	1.356303	0.1760
DAY=27	5.120811	2.741627	1.867800	0.0627
DAY=28	3.060437	2.483796	1.232161	0.2188
DAY=29	2.009626	2.353865	0.853756	0.3939
DAY=30	3.173198	2.366580	1.340837	0.1809
DAY=31	3.143608	2.827586	1.111764	0.2671
MONTH="Aug"	5.038412	1.880310	2.679565	0.0078
MONTH="Dec"	6.040752	1.860466	3.246903	0.0013
MONTH="Feb"	1.297562	1.887866	0.687317	0.4924
MONTH="Jan"	-0.510683	1.781025	-0.286735	0.7745
MONTH="July"	3.973654	1.727319	2.300475	0.0221
MONTH="June"	2.738297	1.740370	1.573400	0.1166
MONTH="Mar"	3.104167	1.650283	1.880990	0.0609
MONTH="May"	-0.153394	1.716038	-0.089389	0.9288
MONTH="Nov"	8.864780	1.776476	4.990092	0.0000
MONTH="Oct"	11.63451	1.916880	6.069503	0.0000
MONTH="Sept"	9.416533	2.388989	3.941639	0.0001

AR(1)	0.138274	0.063586	2.174584	0.0304

R-squared	0.825793	Mean dependent var	60.76921
Adjusted R-squared	0.800353	S.D. dependent var	11.11936
S.E. of regression	4.968337	Akaike info criterion	6.164644
Sum squared resid	7775.578	Schwarz criterion	6.669913
Log likelihood	-1068.801	Hannan-Quinn criter.	6.365507
F-statistic	32.46070	Durbin-Watson stat	1.997736
Prob(F-statistic)	0.000000		

Inverted AR Roots	.14

TEST ON THE RESIDUALS

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.339818	Prob. F(2,313)	0.7122
Obs*R-squared	0.784329	Prob. Chi-Square(2)	0.6756

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Sample: 2 365
Included observations: 362
Coefficient covariance computed using outer product of gradients
Presample and interior missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.206990	5.126285	0.040378	0.9678
LOAD	3.40E-05	0.004374	0.007771	0.9938
SOLAR	-0.000777	0.008747	-0.088872	0.9292
WIND	-8.79E-05	0.001926	-0.045633	0.9636
GAS_PRICE	-0.006727	0.106338	-0.063263	0.9496
DAY=2	0.062699	1.963660	0.031930	0.9745
DAY=3	-0.027592	2.140209	-0.012892	0.9897
DAY=4	0.061466	2.157099	0.028495	0.9773
DAY=5	0.050323	2.138250	0.023535	0.9812
DAY=6	0.038043	2.111705	0.018015	0.9856
DAY=7	0.026845	2.109170	0.012728	0.9899
DAY=8	0.034956	2.105528	0.016602	0.9868
DAY=9	0.046998	2.112703	0.022245	0.9823
DAY=10	0.026371	2.109771	0.012499	0.9900
DAY=11	0.036757	2.105553	0.017457	0.9861
DAY=12	0.047552	2.108114	0.022557	0.9820
DAY=13	0.040557	2.104914	0.019268	0.9846
DAY=14	0.042986	2.104300	0.020428	0.9837
DAY=15	0.032768	2.104088	0.015574	0.9876
DAY=16	0.039122	2.100578	0.018625	0.9852
DAY=17	0.049126	2.103311	0.023356	0.9814
DAY=18	0.045898	2.100085	0.021855	0.9826
DAY=19	0.040714	2.102591	0.019364	0.9846
DAY=20	0.039838	2.103408	0.018940	0.9849
DAY=21	0.042815	2.108750	0.020303	0.9838
DAY=22	0.057303	2.105264	0.027219	0.9783
DAY=23	0.060714	2.107979	0.028802	0.9770
DAY=24	0.059682	2.108741	0.028302	0.9774
DAY=25	0.053163	2.101521	0.025297	0.9798
DAY=26	0.069153	2.109438	0.032783	0.9739
DAY=27	0.062381	2.105528	0.029627	0.9764
DAY=28	0.053506	2.085393	0.025658	0.9795
DAY=29	0.122476	2.146622	0.057055	0.9545
DAY=30	0.055654	2.088791	0.026644	0.9788
DAY=31	-0.011295	2.323536	-0.004861	0.9961
MONTH="Aug"	0.008850	1.783078	0.004963	0.9960

MONTH="Dec"	-0.015828	1.704881	-0.009284	0.9926
MONTH="Feb"	0.006238	1.738707	0.003588	0.9971
MONTH="Jan"	-0.035268	1.647009	-0.021413	0.9829
MONTH="July"	0.016459	1.651887	0.009964	0.9921
MONTH="June"	-0.007746	1.560554	-0.004964	0.9960
MONTH="Mar"	-0.040370	1.595687	-0.025300	0.9798
MONTH="May"	-0.013847	1.582686	-0.008749	0.9930
MONTH="Nov"	-0.035044	1.635810	-0.021423	0.9829
MONTH="Oct"	0.047806	1.637975	0.029186	0.9767
MONTH="Sept"	0.018659	1.736243	0.010747	0.9914
AR(1)	-0.017744	0.546413	-0.032474	0.9741
RESID(-1)	0.010797	0.550804	0.019603	0.9844
RESID(-2)	0.050687	0.095247	0.532156	0.5950

R-squared	0.002167	Mean dependent var	-9.97E-10
Adjusted R-squared	-0.150856	S.D. dependent var	4.641012
S.E. of regression	4.978783	Akaike info criterion	6.173525
Sum squared resid	7758.731	Schwarz criterion	6.700295
Log likelihood	-1068.408	Hannan-Quinn criter.	6.382935
F-statistic	0.014159	Durbin-Watson stat	1.983139
Prob(F-statistic)	1.000000		

SPAIN

MODEL 1

Dependent Variable: PRICE
Method: Least Squares
Sample: 1 365
Included observations: 365

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.314144	3.923431	0.080069	0.9362
DEMAND	5.43E-05	5.12E-06	10.60373	0.0000
DAY=2	1.301276	2.323343	0.560088	0.5758
DAY=3	1.439809	2.327129	0.618706	0.5365
DAY=4	2.275679	2.324705	0.978911	0.3284
DAY=5	4.068491	2.332695	1.744117	0.0821
DAY=6	3.959943	2.326501	1.702102	0.0897
DAY=7	3.878123	2.325696	1.667511	0.0964
DAY=8	6.165858	2.325486	2.651428	0.0084
DAY=9	5.548909	2.329499	2.382018	0.0178
DAY=10	2.389314	2.327560	1.026532	0.3054
DAY=11	0.910321	2.324630	0.391598	0.6956
DAY=12	3.807295	2.332100	1.632561	0.1035
DAY=13	3.614493	2.332890	1.549363	0.1223
DAY=14	3.018345	2.326256	1.297512	0.1954
DAY=15	3.179550	2.321601	1.369551	0.1718
DAY=16	5.312370	2.324738	2.285148	0.0230
DAY=17	4.899836	2.324091	2.108280	0.0358
DAY=18	4.871726	2.323249	2.096946	0.0368
DAY=19	5.066865	2.331996	2.172759	0.0305
DAY=20	3.393212	2.331053	1.455656	0.1465
DAY=21	4.240971	2.325108	1.823989	0.0691
DAY=22	6.798277	2.324837	2.924194	0.0037
DAY=23	7.130231	2.328474	3.062190	0.0024
DAY=24	5.295053	2.324274	2.278153	0.0234
DAY=25	7.558739	2.319886	3.258238	0.0012
DAY=26	6.536252	2.330339	2.804851	0.0053
DAY=27	7.037663	2.330867	3.019332	0.0027
DAY=28	5.783262	2.325457	2.486935	0.0134
DAY=29	3.420339	2.375403	1.439898	0.1509
DAY=30	3.164580	2.375730	1.332046	0.1838
DAY=31	3.643009	2.721075	1.338812	0.1816

MONTH="Aug"	18.66326	1.483682	12.57902	0.0000
MONTH="Dec"	18.13408	1.459562	12.42433	0.0000
MONTH="Feb"	6.781714	1.576758	4.301048	0.0000
MONTH="Jan"	3.765066	1.494437	2.519387	0.0122
MONTH="July"	15.95391	1.488666	10.71692	0.0000
MONTH="June"	14.83828	1.469358	10.09848	0.0000
MONTH="Mar"	-5.114070	1.477500	-3.461300	0.0006
MONTH="May"	13.10562	1.458680	8.984569	0.0000
MONTH="Nov"	17.55043	1.475870	11.89158	0.0000
MONTH="Oct"	22.80800	1.456892	15.65524	0.0000
MONTH="Sept"	26.72870	1.477216	18.09397	0.0000

R-squared	0.766153	Mean dependent var	57.29252
Adjusted R-squared	0.735651	S.D. dependent var	11.04780
S.E. of regression	5.680215	Akaike info criterion	6.422126
Sum squared resid	10389.28	Schwarz criterion	6.881566
Log likelihood	-1129.038	Hannan-Quinn criter.	6.604713
F-statistic	25.11826	Durbin-Watson stat	0.871721
Prob(F-statistic)	0.000000		

Dependent Variable: PRICE
Method: ARMA Conditional Least Squares (Gauss-Newton / Marquardt steps)
Sample (adjusted): 2 365
Included observations: 364 after adjustments
Convergence achieved after 7 iterations
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	8.719197	4.726847	1.844612	0.0660
DEMAND	4.83E-05	5.52E-06	8.739311	0.0000
DAY=2	0.149830	1.375466	0.108930	0.9133
DAY=3	-0.368055	1.923787	-0.191318	0.8484
DAY=4	0.040753	2.249910	0.018113	0.9856
DAY=5	1.725917	2.257886	0.764395	0.4452
DAY=6	1.425162	2.292089	0.621775	0.5345
DAY=7	1.268494	2.260644	0.561121	0.5751
DAY=8	3.518817	2.360341	1.490809	0.1370
DAY=9	2.938543	2.273356	1.292602	0.1971
DAY=10	-0.256244	2.119049	-0.120924	0.9038
DAY=11	-1.784759	3.049104	-0.585339	0.5587
DAY=12	1.208589	2.872738	0.420710	0.6742
DAY=13	1.022734	2.862293	0.357313	0.7211
DAY=14	0.343225	2.546567	0.134780	0.8929
DAY=15	0.418146	2.350671	0.177883	0.8589
DAY=16	2.612583	2.504785	1.043037	0.2977
DAY=17	2.188635	2.334542	0.937501	0.3492
DAY=18	2.144538	2.197425	0.975932	0.3298
DAY=19	2.461818	2.232629	1.102654	0.2710
DAY=20	0.776076	2.269955	0.341890	0.7327
DAY=21	1.541463	2.182142	0.706399	0.4805
DAY=22	4.089551	2.199734	1.859111	0.0639
DAY=23	4.465362	2.155311	2.071795	0.0391
DAY=24	2.551708	2.836675	0.899542	0.3690
DAY=25	4.678758	2.767824	1.690410	0.0919
DAY=26	3.793281	2.455415	1.544864	0.1234
DAY=27	4.199778	2.290835	1.833296	0.0677
DAY=28	2.687448	2.242844	1.198232	0.2317
DAY=29	0.602240	2.421878	0.248667	0.8038
DAY=30	0.782065	2.413964	0.323976	0.7462
DAY=31	1.877974	1.813492	1.035557	0.3012
MONTH="Aug"	17.41618	2.401624	7.251835	0.0000
MONTH="Dec"	16.82834	2.307167	7.293942	0.0000
MONTH="Feb"	4.723434	2.682910	1.760564	0.0793
MONTH="Jan"	4.959022	2.733187	1.814373	0.0706

MONTH="July"	14.94190	2.295053	6.510481	0.0000
MONTH="June"	13.28707	2.500995	5.312713	0.0000
MONTH="Mar"	-6.678627	4.098108	-1.629686	0.1042
MONTH="May"	10.51992	3.096699	3.397141	0.0008
MONTH="Nov"	16.41638	2.523989	6.504142	0.0000
MONTH="Oct"	20.10579	2.580259	7.792159	0.0000
MONTH="Sept"	25.09412	2.431534	10.32029	0.0000
AR(1)	0.543947	0.068644	7.924151	0.0000

R-squared	0.843593	Mean dependent var	57.42893
Adjusted R-squared	0.822576	S.D. dependent var	10.75081
S.E. of regression	4.528428	Akaike info criterion	5.971552
Sum squared resid	6562.131	Schwarz criterion	6.442637
Log likelihood	-1042.822	Hannan-Quinn criter.	6.158787
F-statistic	40.13823	Durbin-Watson stat	1.887877
Prob(F-statistic)	0.000000		

Inverted AR Roots	.54

MODEL 2

Dependent Variable: PRICE
Method: Least Squares
Sample: 1 365
Included observations: 365
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	9.902763	5.183998	1.910256	0.0570
DEMAND	6.03E-05	6.00E-06	10.05090	0.0000
RES	-0.001644	0.000105	-15.72691	0.0000
DAY=2	2.158416	3.092240	0.698011	0.4857
DAY=3	1.933012	3.017031	0.640700	0.5222
DAY=4	1.725826	2.880664	0.599107	0.5495
DAY=5	2.345375	2.852759	0.822143	0.4116
DAY=6	3.077587	2.914052	1.056119	0.2917
DAY=7	1.854991	2.795935	0.663460	0.5075
DAY=8	2.739668	2.744240	0.998334	0.3189
DAY=9	4.163270	2.743773	1.517352	0.1302
DAY=10	2.332511	2.795390	0.834413	0.4047
DAY=11	0.993782	3.421972	0.290412	0.7717
DAY=12	2.144187	2.751632	0.779242	0.4364
DAY=13	2.302166	2.876160	0.800431	0.4241
DAY=14	2.765412	2.779207	0.995036	0.3205
DAY=15	2.071765	2.886957	0.717629	0.4735
DAY=16	3.987896	2.836271	1.406035	0.1607
DAY=17	3.098738	2.781872	1.113904	0.2662
DAY=18	3.391002	2.794319	1.213534	0.2258
DAY=19	3.479492	2.834644	1.227488	0.2205
DAY=20	3.446729	2.819271	1.222560	0.2224
DAY=21	3.223910	2.799634	1.151547	0.2504
DAY=22	4.553312	2.811467	1.619550	0.1063
DAY=23	3.428547	2.724468	1.258428	0.2092
DAY=24	2.754335	2.897325	0.950648	0.3425
DAY=25	4.302684	2.855628	1.506738	0.1329
DAY=26	4.308042	2.817369	1.529101	0.1272
DAY=27	4.414928	2.801053	1.576167	0.1160
DAY=28	3.775905	2.791297	1.352742	0.1771
DAY=29	2.125328	3.060504	0.694437	0.4879
DAY=30	0.776016	3.771645	0.205750	0.8371
DAY=31	-0.322692	3.968708	-0.081309	0.9352
MONTH="Aug"	16.09204	0.921831	17.45662	0.0000
MONTH="Dec"	16.37090	0.931372	17.57719	0.0000
MONTH="Feb"	6.892685	1.017050	6.777133	0.0000

MONTH="Jan"	3.878769	1.328663	2.919304	0.0038
MONTH="July"	12.66192	0.966279	13.10380	0.0000
MONTH="June"	11.27364	0.916303	12.30340	0.0000
MONTH="Mar"	1.037263	1.698063	0.610851	0.5417
MONTH="May"	10.87974	1.036487	10.49675	0.0000
MONTH="Nov"	16.25168	0.912611	17.80788	0.0000
MONTH="Oct"	21.79391	0.890146	24.48354	0.0000
MONTH="Sept"	22.22456	0.901230	24.66025	0.0000

R-squared	0.874906	Mean dependent var	57.29252
Adjusted R-squared	0.858148	S.D. dependent var	11.04780
S.E. of regression	4.160954	Akaike info criterion	5.802005
Sum squared resid	5557.644	Schwarz criterion	6.272130
Log likelihood	-1014.866	Hannan-Quinn criter.	5.988839
F-statistic	52.21077	Durbin-Watson stat	0.938819
Prob(F-statistic)	0.000000	Wald F-statistic	54.10942
Prob(Wald F-statistic)	0.000000		

Dependent Variable: PRICE
Method: ARMA Conditional Least Squares (Gauss-Newton / Marquardt steps)
Sample (adjusted): 2 365
Included observations: 364 after adjustments
Convergence achieved after 7 iterations
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	16.51079	3.537821	4.666937	0.0000
DEMAND	5.37E-05	4.52E-06	11.86861	0.0000
RES	-0.001507	9.78E-05	-15.40211	0.0000
DAY=2	1.133259	1.398270	0.810472	0.4183
DAY=3	0.432142	1.664875	0.259564	0.7954
DAY=4	-0.013399	1.769411	-0.007572	0.9940
DAY=5	0.666448	1.920430	0.347031	0.7288
DAY=6	1.176347	2.009786	0.585309	0.5588
DAY=7	-0.000669	1.978260	-0.000338	0.9997
DAY=8	0.978803	1.950359	0.501858	0.6161
DAY=9	2.279926	1.947720	1.170562	0.2426
DAY=10	0.307919	1.942731	0.158498	0.8742
DAY=11	-1.090217	2.718111	-0.401094	0.6886
DAY=12	0.306718	2.432619	0.126086	0.8997
DAY=13	0.443711	2.259042	0.196416	0.8444
DAY=14	0.733543	2.105056	0.348467	0.7277
DAY=15	0.022630	2.048320	0.011048	0.9912
DAY=16	2.020503	2.011045	1.004703	0.3158
DAY=17	1.159515	1.999435	0.579921	0.5624
DAY=18	1.408912	1.956392	0.720158	0.4720
DAY=19	1.632419	2.028435	0.804768	0.4216
DAY=20	1.451180	2.003337	0.724382	0.4694
DAY=21	1.233687	1.985538	0.621337	0.5348
DAY=22	2.657392	1.967650	1.350541	0.1778
DAY=23	1.701425	1.939469	0.877263	0.3810
DAY=24	0.853086	2.266322	0.376419	0.7069
DAY=25	2.324580	2.253305	1.031632	0.3030
DAY=26	2.389443	2.079479	1.149059	0.2514
DAY=27	2.431459	2.055172	1.183093	0.2377
DAY=28	1.460899	2.105322	0.693908	0.4882
DAY=29	0.122066	2.263672	0.053924	0.9570
DAY=30	-0.804037	2.326654	-0.345577	0.7299
DAY=31	-0.862010	1.733560	-0.497249	0.6194
MONTH="Aug"	15.56779	1.626426	9.571784	0.0000
MONTH="Dec"	15.67859	1.533521	10.22392	0.0000
MONTH="Feb"	5.858706	1.770658	3.308773	0.0010
MONTH="Jan"	4.848356	1.772494	2.735329	0.0066
MONTH="July"	12.30949	1.600102	7.692940	0.0000

MONTH="June"	10.69943	1.574036	6.797452	0.0000
MONTH="Mar"	-0.302271	3.063883	-0.098656	0.9215
MONTH="May"	9.204697	2.254441	4.082918	0.0001
MONTH="Nov"	15.69232	1.635356	9.595660	0.0000
MONTH="Oct"	20.15606	1.580139	12.75587	0.0000
MONTH="Sept"	21.27300	1.590859	13.37202	0.0000
AR(1)	0.505083	0.091968	5.491976	0.0000

R-squared	0.914221	Mean dependent var	57.42893
Adjusted R-squared	0.902390	S.D. dependent var	10.75081
S.E. of regression	3.358840	Akaike info criterion	5.376358
Sum squared resid	3598.896	Schwarz criterion	5.858149
Log likelihood	-933.4972	Hannan-Quinn criter.	5.567848
F-statistic	77.26960	Durbin-Watson stat	1.891351
Prob(F-statistic)	0.000000		

Inverted AR Roots	.51

MODEL 3

Dependent Variable: PRICE
Method: Least Squares
Sample: 1 365
Included observations: 365
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	9.849050	5.154696	1.910694	0.0569
DEMAND	6.03E-05	6.03E-06	10.00630	0.0000
SOLAR	-0.001597	0.000574	-2.784062	0.0057
WIND	-0.001645	0.000104	-15.74422	0.0000
DAY=2	2.163692	3.101622	0.697600	0.4859
DAY=3	1.934851	3.022699	0.640107	0.5226
DAY=4	1.727553	2.887389	0.598310	0.5501
DAY=5	2.350180	2.862147	0.821125	0.4122
DAY=6	3.082080	2.923593	1.054209	0.2926
DAY=7	1.858457	2.804119	0.662760	0.5080
DAY=8	2.746458	2.756506	0.996355	0.3198
DAY=9	4.171347	2.758933	1.511942	0.1315
DAY=10	2.341937	2.812103	0.832806	0.4056
DAY=11	1.002260	3.427461	0.292421	0.7702
DAY=12	2.150723	2.764250	0.778049	0.4371
DAY=13	2.301805	2.882067	0.798665	0.4251
DAY=14	2.768728	2.786096	0.993766	0.3211
DAY=15	2.070833	2.891426	0.716198	0.4744
DAY=16	3.980488	2.838396	1.402372	0.1618
DAY=17	3.089888	2.780605	1.111229	0.2673
DAY=18	3.389702	2.797085	1.211870	0.2265
DAY=19	3.475969	2.836287	1.225535	0.2213
DAY=20	3.445686	2.823602	1.220315	0.2232
DAY=21	3.220759	2.800942	1.149884	0.2511
DAY=22	4.542913	2.801667	1.621503	0.1059
DAY=23	3.425168	2.727308	1.255879	0.2101
DAY=24	2.747871	2.900283	0.947449	0.3441
DAY=25	4.301443	2.860548	1.503713	0.1336
DAY=26	4.303327	2.817024	1.527615	0.1276
DAY=27	4.410752	2.803476	1.573316	0.1166
DAY=28	3.775129	2.795552	1.350406	0.1778
DAY=29	2.119159	3.060750	0.692366	0.4892
DAY=30	0.779002	3.782514	0.205948	0.8370
DAY=31	-0.329656	3.957967	-0.083289	0.9337
MONTH="Aug"	16.06044	1.002362	16.02260	0.0000
MONTH="Dec"	16.40411	0.984426	16.66363	0.0000
MONTH="Feb"	6.910402	1.050264	6.579683	0.0000

MONTH="Jan"	3.913586	1.392959	2.809549	0.0053
MONTH="July"	12.61299	1.122772	11.23380	0.0000
MONTH="June"	11.24875	0.964295	11.66526	0.0000
MONTH="Mar"	1.059221	1.702798	0.622048	0.5344
MONTH="May"	10.86295	1.080794	10.05090	0.0000
MONTH="Nov"	16.29002	1.032678	15.77454	0.0000
MONTH="Oct"	21.80656	0.897355	24.30092	0.0000
MONTH="Sept"	22.21088	0.911105	24.37795	0.0000

R-squared	0.874909	Mean dependent var	57.29252
Adjusted R-squared	0.857708	S.D. dependent var	11.04780
S.E. of regression	4.167402	Akaike info criterion	5.807462
Sum squared resid	5557.517	Schwarz criterion	6.288271
Log likelihood	-1014.862	Hannan-Quinn criter.	5.998542
F-statistic	50.86655	Durbin-Watson stat	0.937695
Prob(F-statistic)	0.000000	Wald F-statistic	52.86920
Prob(Wald F-statistic)	0.000000		

Dependent Variable: PRICE
Method: ARMA Conditional Least Squares (Gauss-Newton / Marquardt steps)
Sample (adjusted): 2 365
Included observations: 364 after adjustments
Convergence achieved after 7 iterations
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	15.39264	3.605138	4.269640	0.0000
DEMAND	5.33E-05	4.49E-06	11.88920	0.0000
SOLAR	-0.000472	0.000489	-0.965345	0.3351
WIND	-0.001517	9.87E-05	-15.36514	0.0000
DAY=2	1.280555	1.401018	0.914018	0.3614
DAY=3	0.514569	1.651408	0.311594	0.7556
DAY=4	0.072384	1.768308	0.040934	0.9674
DAY=5	0.827720	1.920366	0.431022	0.6667
DAY=6	1.312979	2.010263	0.653138	0.5141
DAY=7	0.123224	1.990233	0.061914	0.9507
DAY=8	1.189244	1.976835	0.601590	0.5479
DAY=9	2.492449	1.982008	1.257537	0.2095
DAY=10	0.531852	1.980421	0.268555	0.7884
DAY=11	-0.889974	2.727912	-0.326247	0.7445
DAY=12	0.487736	2.460005	0.198266	0.8430
DAY=13	0.470704	2.305302	0.204183	0.8383
DAY=14	0.825673	2.117307	0.389964	0.6968
DAY=15	0.031520	2.056509	0.015327	0.9878
DAY=16	1.892569	2.009484	0.941818	0.3470
DAY=17	1.005885	2.023147	0.497188	0.6194
DAY=18	1.414789	1.968323	0.718779	0.4728
DAY=19	1.593402	2.047654	0.778160	0.4371
DAY=20	1.445306	2.025083	0.713702	0.4759
DAY=21	1.193338	1.968053	0.606355	0.5447
DAY=22	2.473967	1.936003	1.277873	0.2022
DAY=23	1.687746	1.956431	0.862666	0.3890
DAY=24	0.754678	2.291103	0.329395	0.7421
DAY=25	2.342578	2.284188	1.025562	0.3059
DAY=26	2.317027	2.090576	1.108320	0.2686
DAY=27	2.367514	2.088285	1.133712	0.2578
DAY=28	1.451992	2.136750	0.679533	0.4973
DAY=29	0.054052	2.258303	0.023935	0.9809
DAY=30	-0.661138	2.276492	-0.290419	0.7717
DAY=31	-0.861231	1.717109	-0.501559	0.6163
MONTH="Aug"	14.83441	1.696490	8.744175	0.0000
MONTH="Dec"	16.33272	1.569294	10.40769	0.0000
MONTH="Feb"	6.158419	1.821110	3.381684	0.0008

MONTH="Jan"	5.501560	1.794034	3.066586	0.0024
MONTH="July"	11.22836	1.711299	6.561312	0.0000
MONTH="June"	10.08403	1.615439	6.242285	0.0000
MONTH="Mar"	-0.034020	3.136462	-0.010847	0.9914
MONTH="May"	8.727814	2.321844	3.759000	0.0002
MONTH="Nov"	16.34530	1.652730	9.889876	0.0000
MONTH="Oct"	20.35545	1.551508	13.11979	0.0000
MONTH="Sept"	20.88211	1.632173	12.79405	0.0000
AR(1)	0.520068	0.094077	5.528141	0.0000

R-squared	0.915140	Mean dependent var	57.42893
Adjusted R-squared	0.903131	S.D. dependent var	10.75081
S.E. of regression	3.346051	Akaike info criterion	5.371083
Sum squared resid	3560.346	Schwarz criterion	5.863581
Log likelihood	-931.5372	Hannan-Quinn criter.	5.566829
F-statistic	76.20765	Durbin-Watson stat	1.906464
Prob(F-statistic)	0.000000		

Inverted AR Roots	.52

MODEL 4

Dependent Variable: PRICE
Method: Least Squares
Sample: 1 365
Included observations: 365
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-4.637218	5.730762	-0.809180	0.4190
DEMAND	5.08E-05	6.37E-06	7.965582	0.0000
SOLAR	-0.000770	0.000526	-1.464853	0.1439
WIND	-0.001577	0.000106	-14.92840	0.0000
GAS_PRICE	0.897159	0.234037	3.833411	0.0002
DAY=2	2.234775	2.983738	0.748985	0.4544
DAY=3	2.659194	2.831023	0.939305	0.3483
DAY=4	2.694119	2.718157	0.991157	0.3224
DAY=5	3.418002	2.667315	1.281439	0.2010
DAY=6	4.088700	2.789059	1.465979	0.1436
DAY=7	2.980563	2.656486	1.121995	0.2627
DAY=8	3.776104	2.589985	1.457964	0.1458
DAY=9	5.260977	2.591853	2.029813	0.0432
DAY=10	3.396998	2.653838	1.280032	0.2015
DAY=11	2.020625	3.278395	0.616346	0.5381
DAY=12	3.055429	2.615820	1.168058	0.2437
DAY=13	3.083497	2.793880	1.103661	0.2706
DAY=14	3.581478	2.664739	1.344026	0.1799
DAY=15	2.587703	2.828870	0.914748	0.3610
DAY=16	4.465160	2.772696	1.610404	0.1083
DAY=17	3.763735	2.756937	1.365187	0.1732
DAY=18	4.257937	2.692223	1.581569	0.1147
DAY=19	4.420382	2.682686	1.647745	0.1004
DAY=20	4.555470	2.687352	1.695152	0.0910
DAY=21	4.348025	2.660665	1.634187	0.1032
DAY=22	5.392327	2.702297	1.995460	0.0468
DAY=23	4.508844	2.618843	1.721693	0.0861
DAY=24	3.572781	2.768979	1.290288	0.1979
DAY=25	5.148589	2.737467	1.880786	0.0609
DAY=26	5.150646	2.695681	1.910703	0.0569
DAY=27	5.087574	2.706992	1.879420	0.0611
DAY=28	4.006716	2.831376	1.415112	0.1580
DAY=29	3.061887	2.912747	1.051203	0.2940
DAY=30	1.797954	3.419168	0.525846	0.5994
DAY=31	0.501726	3.491812	0.143687	0.8858

MONTH="Aug"	11.38141	1.462825	7.780432	0.0000
MONTH="Dec"	13.31833	1.299610	10.24794	0.0000
MONTH="Feb"	6.594524	1.024654	6.435852	0.0000
MONTH="Jan"	5.465596	1.584334	3.449774	0.0006
MONTH="July"	8.833427	1.360313	6.493671	0.0000
MONTH="June"	9.378034	1.058602	8.858885	0.0000
MONTH="Mar"	-0.860739	1.785474	-0.482079	0.6301
MONTH="May"	9.319111	1.056025	8.824704	0.0000
MONTH="Nov"	12.60826	1.477460	8.533741	0.0000
MONTH="Oct"	16.77347	1.574944	10.65020	0.0000
MONTH="Sept"	15.35754	1.961451	7.829684	0.0000

R-squared	0.887011	Mean dependent var	57.29252
Adjusted R-squared	0.871073	S.D. dependent var	11.04780
S.E. of regression	3.966875	Akaike info criterion	5.711183
Sum squared resid	5019.815	Schwarz criterion	6.202677
Log likelihood	-996.2909	Hannan-Quinn criter.	5.906509
F-statistic	55.65098	Durbin-Watson stat	1.022230
Prob(F-statistic)	0.000000	Wald F-statistic	56.66456
Prob(Wald F-statistic)	0.000000		

Dependent Variable: PRICE
Method: ARMA Conditional Least Squares (Gauss-Newton / Marquardt steps)
Sample (adjusted): 2 365
Included observations: 364 after adjustments
Convergence achieved after 8 iterations
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.432261	6.673373	-0.064774	0.9484
DEMAND	4.51E-05	4.29E-06	10.51728	0.0000
SOLAR	-0.000162	0.000487	-0.333032	0.7393
WIND	-0.001444	9.82E-05	-14.70310	0.0000
GAS_PRICE	0.943537	0.294766	3.200968	0.0015
DAY=2	0.824685	1.283520	0.642518	0.5210
DAY=3	0.660608	1.530148	0.431728	0.6662
DAY=4	0.473607	1.583477	0.299093	0.7651
DAY=5	1.281248	1.694918	0.755935	0.4502
DAY=6	1.757254	1.774993	0.990006	0.3229
DAY=7	0.709674	1.743805	0.406968	0.6843
DAY=8	1.638003	1.665404	0.983547	0.3261
DAY=9	2.998621	1.661758	1.804487	0.0721
DAY=10	1.009026	1.656155	0.609258	0.5428
DAY=11	-0.424467	2.526504	-0.168006	0.8667
DAY=12	0.812999	2.066037	0.393507	0.6942
DAY=13	0.748273	2.005311	0.373145	0.7093
DAY=14	1.126775	1.779276	0.633277	0.5270
DAY=15	0.087628	1.755540	0.049915	0.9602
DAY=16	1.970674	1.688316	1.167242	0.2440
DAY=17	1.298668	1.764940	0.735814	0.4624
DAY=18	1.831835	1.678730	1.091203	0.2760
DAY=19	2.080922	1.717480	1.211613	0.2266
DAY=20	2.097034	1.692858	1.238754	0.2164
DAY=21	1.902577	1.639180	1.160688	0.2466
DAY=22	2.968453	1.649411	1.799705	0.0729
DAY=23	2.324289	1.670755	1.391161	0.1652
DAY=24	1.193842	1.992847	0.599064	0.5496
DAY=25	2.786360	1.943171	1.433924	0.1526
DAY=26	2.786978	1.737825	1.603716	0.1098
DAY=27	2.696292	1.706643	1.579881	0.1151
DAY=28	1.373670	1.783649	0.770146	0.4418
DAY=29	0.220145	1.964572	0.112057	0.9108
DAY=30	-0.469480	2.144708	-0.218902	0.8269
DAY=31	-0.942227	1.583331	-0.595092	0.5522

MONTH="Aug"	10.74324	2.123902	5.058255	0.0000
MONTH="Dec"	13.20710	1.849830	7.139632	0.0000
MONTH="Feb"	6.137844	1.568667	3.912776	0.0001
MONTH="Jan"	7.155834	1.495898	4.783638	0.0000
MONTH="July"	8.183448	1.936841	4.225152	0.0000
MONTH="June"	8.929957	1.558370	5.730318	0.0000
MONTH="Mar"	-1.455180	2.726663	-0.533685	0.5939
MONTH="May"	8.107852	1.927620	4.206147	0.0000
MONTH="Nov"	12.46509	2.045858	6.092844	0.0000
MONTH="Oct"	15.72830	2.205405	7.131705	0.0000
MONTH="Sept"	14.63293	2.675867	5.468480	0.0000
AR(1)	0.441549	0.084059	5.252834	0.0000

R-squared	0.920752	Mean dependent var	57.42893
Adjusted R-squared	0.909252	S.D. dependent var	10.75081
S.E. of regression	3.238616	Akaike info criterion	5.308159
Sum squared resid	3324.897	Schwarz criterion	5.811363
Log likelihood	-919.0849	Hannan-Quinn criter.	5.508159
F-statistic	80.06718	Durbin-Watson stat	1.912288
Prob(F-statistic)	0.000000		

Inverted AR Roots	.44

TEST ON THE RESIDUALS

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.414585	Prob. F(2,315)	0.2446
Obs*R-squared	3.240162	Prob. Chi-Square(2)	0.1979

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Sample: 2 365
Included observations: 364
Coefficient covariance computed using outer product of gradients
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.149915	4.193233	0.035752	0.9715
DEMAND	2.84E-07	3.83E-06	0.074074	0.9410
SOLAR	2.40E-05	0.000538	0.044486	0.9645
WIND	-2.44E-05	9.24E-05	-0.264465	0.7916
GAS_PRICE	-0.006795	0.188598	-0.036031	0.9713
DAY=2	-0.429918	1.148209	-0.374425	0.7083
DAY=3	-0.383216	1.361268	-0.281514	0.7785
DAY=4	-0.274734	1.439025	-0.190917	0.8487
DAY=5	-0.193098	1.478350	-0.130617	0.8962
DAY=6	-0.118052	1.486937	-0.079393	0.9368
DAY=7	-0.099749	1.496767	-0.066643	0.9469
DAY=8	-0.094944	1.506345	-0.063030	0.9498
DAY=9	-0.057271	1.502616	-0.038114	0.9696
DAY=10	-0.031643	1.502128	-0.021065	0.9832
DAY=11	-0.026911	1.500315	-0.017937	0.9857
DAY=12	-0.052946	1.502471	-0.035239	0.9719
DAY=13	-0.054562	1.499062	-0.036397	0.9710
DAY=14	-0.034080	1.496507	-0.022773	0.9818
DAY=15	-0.046155	1.493599	-0.030902	0.9754
DAY=16	-0.057476	1.496208	-0.038415	0.9694
DAY=17	-0.066731	1.497943	-0.044549	0.9645
DAY=18	-0.054989	1.495968	-0.036758	0.9707
DAY=19	-0.062295	1.500705	-0.041511	0.9669
DAY=20	-0.038200	1.501402	-0.025443	0.9797
DAY=21	-0.053471	1.499377	-0.035662	0.9716

DAY=22	-0.076148	1.501303	-0.050721	0.9596
DAY=23	-0.091098	1.508589	-0.060386	0.9519
DAY=24	-0.075554	1.497480	-0.050454	0.9598
DAY=25	-0.077493	1.495786	-0.051807	0.9587
DAY=26	-0.072514	1.487430	-0.048751	0.9611
DAY=27	-0.077815	1.469817	-0.052942	0.9578
DAY=28	-0.064456	1.421103	-0.045356	0.9639
DAY=29	-0.071929	1.412166	-0.050935	0.9594
DAY=30	-0.075983	1.298207	-0.058529	0.9534
DAY=31	0.002630	1.383740	0.001901	0.9985
MONTH="Aug"	-0.029123	1.748036	-0.016660	0.9867
MONTH="Dec"	0.009282	1.634021	0.005680	0.9955
MONTH="Feb"	-0.005275	1.523618	-0.003462	0.9972
MONTH="Jan"	-0.453996	1.583408	-0.286721	0.7745
MONTH="July"	-0.107532	1.703147	-0.063137	0.9497
MONTH="June"	-0.018439	1.510205	-0.012210	0.9903
MONTH="Mar"	0.136449	1.532239	0.089052	0.9291
MONTH="May"	-0.063012	1.444445	-0.043623	0.9652
MONTH="Nov"	0.087002	1.710147	0.050874	0.9595
MONTH="Oct"	0.032114	1.790473	0.017936	0.9857
MONTH="Sept"	-0.023772	2.010434	-0.011824	0.9906
AR(1)	-0.144218	0.097914	-1.472906	0.1418
RESID(-1)	0.177491	0.112272	1.580902	0.1149
RESID(-2)	0.092545	0.071969	1.285899	0.1994

R-squared	0.008902	Mean dependent var	2.20E-11
Adjusted R-squared	-0.142123	S.D. dependent var	3.026466
S.E. of regression	3.234389	Akaike info criterion	5.310206
Sum squared resid	3295.300	Schwarz criterion	5.834823
Log likelihood	-917.4576	Hannan-Quinn criter.	5.518718
F-statistic	0.058941	Durbin-Watson stat	1.980101
Prob(F-statistic)	1.000000		

MODEL 5

Dependent Variable: PRICE
Method: Least Squares
Sample: 1 365
Included observations: 365
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.520274	5.066385	-0.300071	0.7643
DEMAND	6.60E-05	7.65E-06	8.621467	0.0000
SOLAR	-0.000993	0.000524	-1.893253	0.0592
WIND	-0.001852	0.000124	-14.89912	0.0000
GAS_PRICE	0.855219	0.193325	4.423735	0.0000
HYDRO	-0.002272	0.000408	-5.566440	0.0000
DAY=2	2.722372	2.720666	1.000627	0.3178
DAY=3	3.528576	2.574854	1.370398	0.1715
DAY=4	2.949025	2.449970	1.203698	0.2296
DAY=5	3.972697	2.465048	1.611611	0.1080
DAY=6	4.337175	2.500434	1.734569	0.0838
DAY=7	3.262406	2.405095	1.356456	0.1759
DAY=8	3.703109	2.343669	1.580048	0.1151
DAY=9	5.088145	2.379914	2.137953	0.0333
DAY=10	3.677069	2.506958	1.466746	0.1434
DAY=11	3.298320	3.175473	1.038686	0.2997
DAY=12	4.398026	2.497707	1.760825	0.0792
DAY=13	3.833734	2.671267	1.435174	0.1522
DAY=14	4.158309	2.444162	1.701323	0.0899
DAY=15	3.327812	2.597221	1.281297	0.2010
DAY=16	5.439149	2.604231	2.088582	0.0375
DAY=17	4.792513	2.592915	1.848311	0.0655
DAY=18	5.365397	2.581893	2.078086	0.0385

DAY=19	5.644485	2.537977	2.224010	0.0268
DAY=20	6.033976	2.589461	2.330206	0.0204
DAY=21	5.576012	2.566727	2.172421	0.0306
DAY=22	6.045180	2.527054	2.392185	0.0173
DAY=23	5.492316	2.481166	2.213602	0.0276
DAY=24	4.125069	2.566057	1.607552	0.1089
DAY=25	5.722762	2.550367	2.243897	0.0255
DAY=26	5.779626	2.508061	2.304420	0.0218
DAY=27	6.025236	2.527728	2.383657	0.0177
DAY=28	4.727294	2.603873	1.815486	0.0704
DAY=29	3.241421	2.715642	1.193611	0.2335
DAY=30	2.087529	3.218918	0.648519	0.5171
DAY=31	0.585338	3.222274	0.181654	0.8560
MONTH="Aug"	3.455432	1.942230	1.779105	0.0762
MONTH="Dec"	6.855590	1.685330	4.067803	0.0001
MONTH="Feb"	-0.167236	1.811106	-0.092339	0.9265
MONTH="Jan"	-1.929834	2.499519	-0.772082	0.4406
MONTH="July"	2.601694	1.737413	1.497452	0.1353
MONTH="June"	4.964982	1.306211	3.801057	0.0002
MONTH="Mar"	-1.232575	1.778864	-0.692900	0.4889
MONTH="May"	4.882515	1.234672	3.954505	0.0001
MONTH="Nov"	5.391354	1.887450	2.856423	0.0046
MONTH="Oct"	9.222702	1.809190	5.097697	0.0000
MONTH="Sept"	7.528474	2.121375	3.548866	0.0004

R-squared	0.897741	Mean dependent var	57.29252
Adjusted R-squared	0.882948	S.D. dependent var	11.04780
S.E. of regression	3.779763	Akaike info criterion	5.616888
Sum squared resid	4543.142	Schwarz criterion	6.119067
Log likelihood	-978.0821	Hannan-Quinn criter.	5.816460
F-statistic	60.68997	Durbin-Watson stat	1.110481
Prob(F-statistic)	0.000000	Wald F-statistic	58.46765
Prob(Wald F-statistic)	0.000000		

Dependent Variable: PRICE
Method: ARMA Conditional Least Squares (Gauss-Newton / Marquardt steps)
Sample (adjusted): 2 365
Included observations: 364 after adjustments
Convergence achieved after 7 iterations
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.032002	6.094640	0.169329	0.8656
DEMAND	5.52E-05	5.05E-06	10.94627	0.0000
SOLAR	-0.000397	0.000489	-0.810617	0.4182
WIND	-0.001672	0.000113	-14.80693	0.0000
GAS_PRICE	0.946026	0.254077	3.723391	0.0002
HYDRO	-0.001518	0.000387	-3.918445	0.0001
DAY=2	1.215677	1.173930	1.035561	0.3012
DAY=3	1.398913	1.356874	1.030982	0.3033
DAY=4	0.835779	1.361898	0.613686	0.5399
DAY=5	1.840922	1.504484	1.223624	0.2220
DAY=6	2.155197	1.529847	1.408767	0.1599
DAY=7	1.111402	1.494054	0.743883	0.4575
DAY=8	1.758256	1.407026	1.249626	0.2124
DAY=9	3.114548	1.451358	2.145955	0.0326
DAY=10	1.465280	1.467492	0.998493	0.3188
DAY=11	0.703648	2.396126	0.293661	0.7692
DAY=12	1.930715	1.887901	1.022678	0.3072
DAY=13	1.486098	1.810640	0.820758	0.4124
DAY=14	1.777038	1.500825	1.184041	0.2373
DAY=15	0.818623	1.491714	0.548780	0.5835
DAY=16	2.858786	1.488486	1.920600	0.0557
DAY=17	2.217887	1.542551	1.437805	0.1515

DAY=18	2.809349	1.488375	1.887528	0.0600
DAY=19	3.137527	1.507430	2.081374	0.0382
DAY=20	3.374611	1.526372	2.210870	0.0278
DAY=21	2.985918	1.463666	2.040027	0.0422
DAY=22	3.632673	1.448118	2.508548	0.0126
DAY=23	3.165370	1.475757	2.144912	0.0327
DAY=24	1.780871	1.769649	1.006341	0.3150
DAY=25	3.368844	1.722639	1.955629	0.0514
DAY=26	3.454579	1.501481	2.300782	0.0221
DAY=27	3.584309	1.453600	2.465814	0.0142
DAY=28	2.182934	1.472097	1.482874	0.1391
DAY=29	0.689582	1.774179	0.388677	0.6978
DAY=30	-0.164184	2.032499	-0.080779	0.9357
DAY=31	-0.778004	1.437869	-0.541081	0.5888
MONTH="Aug"	5.490547	2.430621	2.258907	0.0246
MONTH="Dec"	8.873429	2.089480	4.246717	0.0000
MONTH="Feb"	1.953567	1.938935	1.007547	0.3144
MONTH="Jan"	2.293262	1.965488	1.166765	0.2442
MONTH="July"	4.031313	2.141923	1.882100	0.0607
MONTH="June"	5.975189	1.706474	3.501483	0.0005
MONTH="Mar"	-1.601415	2.570975	-0.622882	0.5338
MONTH="May"	5.390457	1.905179	2.829371	0.0050
MONTH="Nov"	7.569574	2.319852	3.262956	0.0012
MONTH="Oct"	10.75215	2.434195	4.417127	0.0000
MONTH="Sept"	9.300277	2.832962	3.282880	0.0011
AR(1)	0.403398	0.084583	4.769249	0.0000

R-squared	0.923997	Mean dependent var	57.42893
Adjusted R-squared	0.912692	S.D. dependent var	10.75081
S.E. of regression	3.176634	Akaike info criterion	5.271846
Sum squared resid	3188.756	Schwarz criterion	5.785756
Log likelihood	-911.4759	Hannan-Quinn criter.	5.476102
F-statistic	81.73855	Durbin-Watson stat	1.894286
Prob(F-statistic)	0.000000		

Inverted AR Roots	.40

TEST ON THE RESIDUALS

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.603658	Prob. F(2,314)	0.2028
Obs*R-squared	3.680443	Prob. Chi-Square(2)	0.1588

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 04/01/20 Time: 16:04
Sample: 2 365
Included observations: 364
Coefficient covariance computed using outer product of gradients

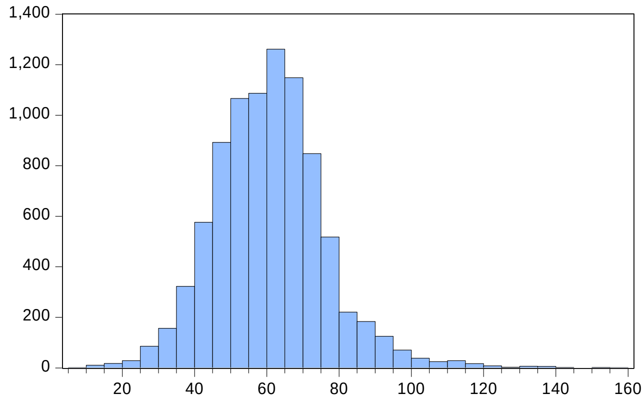
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.271205	4.023937	0.067398	0.9463
DEMAND	5.97E-07	4.65E-06	0.128353	0.8980
SOLAR	2.52E-05	0.000526	0.047924	0.9618
WIND	-3.10E-05	0.000109	-0.285426	0.7755
GAS_PRICE	-0.016866	0.178176	-0.094661	0.9246
HYDRO	-3.41E-05	0.000408	-0.083604	0.9334
DAY=2	-0.403545	1.148315	-0.351424	0.7255
DAY=3	-0.306850	1.348624	-0.227528	0.8202
DAY=4	-0.189523	1.401435	-0.135235	0.8925
DAY=5	-0.102650	1.438397	-0.071364	0.9432
DAY=6	-0.037003	1.439359	-0.025708	0.9795
DAY=7	-0.027144	1.446862	-0.018760	0.9850

DAY=8	-0.031771	1.451512	-0.021888	0.9826
DAY=9	0.002638	1.447338	0.001822	0.9985
DAY=10	0.034796	1.451632	0.023970	0.9809
DAY=11	0.053395	1.476140	0.036172	0.9712
DAY=12	0.027224	1.477801	0.018422	0.9853
DAY=13	0.015836	1.456581	0.010872	0.9913
DAY=14	0.034937	1.451148	0.024076	0.9808
DAY=15	0.026070	1.451252	0.017964	0.9857
DAY=16	0.016553	1.459806	0.011339	0.9910
DAY=17	0.005247	1.462665	0.003587	0.9971
DAY=18	0.018669	1.463701	0.012755	0.9898
DAY=19	0.011913	1.471918	0.008093	0.9935
DAY=20	0.040114	1.484713	0.027018	0.9785
DAY=21	0.019159	1.471703	0.013018	0.9896
DAY=22	-0.012445	1.455953	-0.008548	0.9932
DAY=23	-0.023677	1.470128	-0.016105	0.9872
DAY=24	-0.012072	1.450899	-0.008321	0.9934
DAY=25	-0.013108	1.450502	-0.009037	0.9928
DAY=26	-0.006862	1.446614	-0.004744	0.9962
DAY=27	-0.005721	1.441820	-0.003968	0.9968
DAY=28	0.010390	1.397857	0.007433	0.9941
DAY=29	-0.008702	1.384885	-0.006283	0.9950
DAY=30	0.002580	1.281704	0.002013	0.9984
DAY=31	0.100479	1.375234	0.073063	0.9418
MONTH="Aug"	-0.100267	2.146453	-0.046713	0.9628
MONTH="Dec"	-0.036178	1.896499	-0.019076	0.9848
MONTH="Feb"	-0.083912	1.817306	-0.046174	0.9632
MONTH="Jan"	-0.535529	1.974830	-0.271177	0.7864
MONTH="July"	-0.162552	1.940480	-0.083769	0.9333
MONTH="June"	-0.064076	1.610890	-0.039777	0.9683
MONTH="Mar"	0.200130	1.431362	0.139818	0.8889
MONTH="May"	-0.126796	1.545216	-0.082057	0.9347
MONTH="Nov"	0.044630	2.043364	0.021841	0.9826
MONTH="Oct"	-0.008326	2.121783	-0.003924	0.9969
MONTH="Sept"	-0.061748	2.346804	-0.026311	0.9790
AR(1)	-0.167678	0.105521	-1.589039	0.1131
RESID(-1)	0.211427	0.118405	1.785623	0.0751
RESID(-2)	0.071812	0.071776	1.000512	0.3178

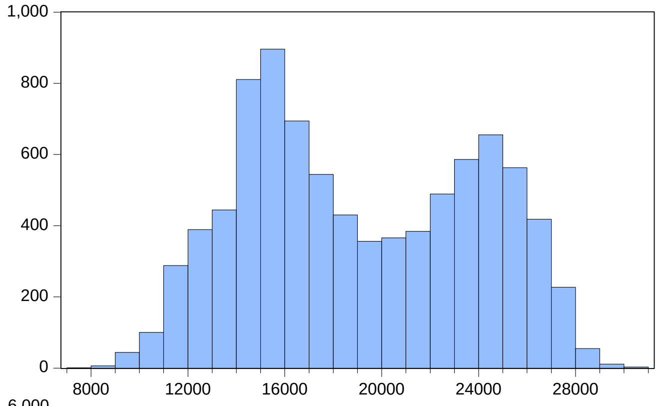
R-squared	0.010111	Mean dependent var	1.43E-10
Adjusted R-squared	-0.144362	S.D. dependent var	2.963858
S.E. of regression	3.170583	Akaike info criterion	5.272672
Sum squared resid	3156.515	Schwarz criterion	5.807996
Log likelihood	-909.6263	Hannan-Quinn criter.	5.485439
F-statistic	0.065455	Durbin-Watson stat	1.982430
Prob(F-statistic)	1.000000		

JARQUE BERA TEST

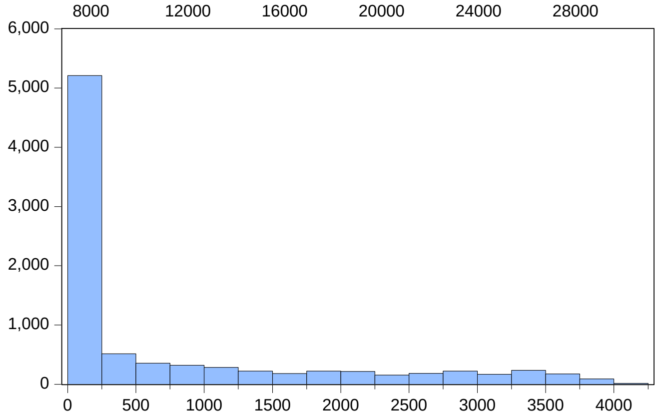
NORTH



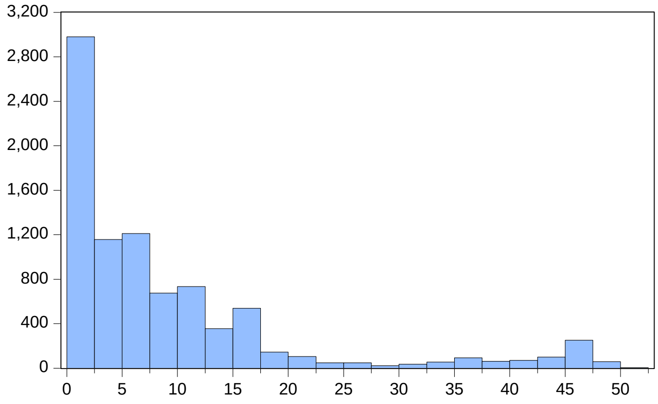
Series: ZONAL_PRICE_NORD	
Sample 1 52567	
Observations 8760	
Mean	60.71300
Median	60.40235
Maximum	159.4000
Minimum	9.390860
Std. Dev.	15.41304
Skewness	0.609361
Kurtosis	5.067615
Jarque-Bera	2102.515
Probability	0.000000



Series: LOAD_NORD	
Sample 1 52567	
Observations 8760	
Mean	19115.06
Median	18404.50
Maximum	30530.00
Minimum	7990.000
Std. Dev.	4795.712
Skewness	0.125775
Kurtosis	1.806053
Jarque-Bera	543.4067
Probability	0.000000

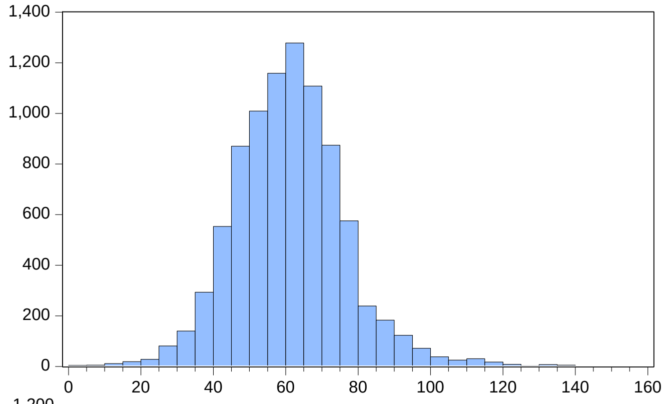


Series: SOLAR_NORD	
Sample 1 52567	
Observations 8751	
Mean	726.4462
Median	7.000000
Maximum	4111.000
Minimum	0.000000
Std. Dev.	1115.249
Skewness	1.434314
Kurtosis	3.722867
Jarque-Bera	3191.039
Probability	0.000000

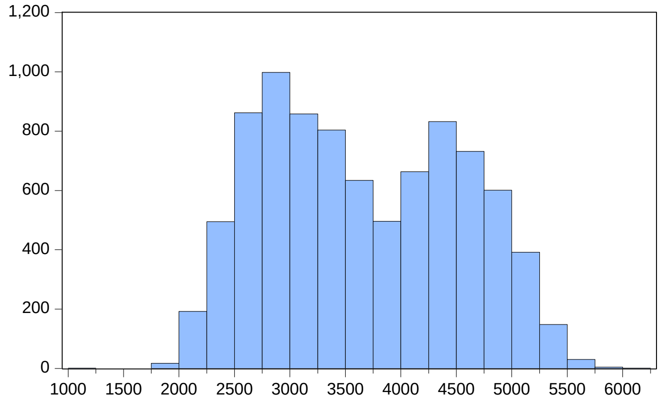


Series: WIND_NORD	
Sample 1 52567	
Observations 8741	
Mean	9.204096
Median	5.000000
Maximum	50.00000
Minimum	0.000000
Std. Dev.	11.33836
Skewness	2.066748
Kurtosis	6.692023
Jarque-Bera	11187.33
Probability	0.000000

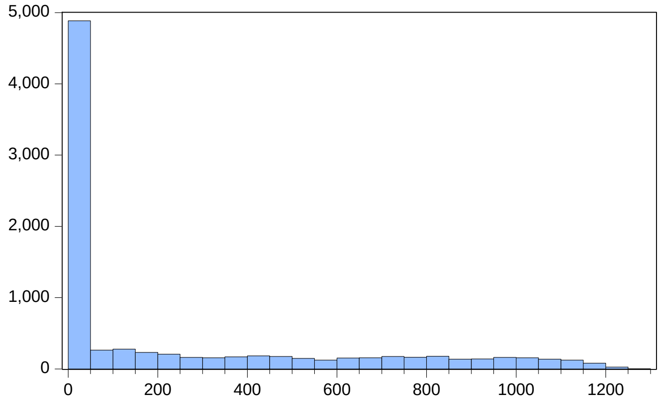
CENTRAL NORTH



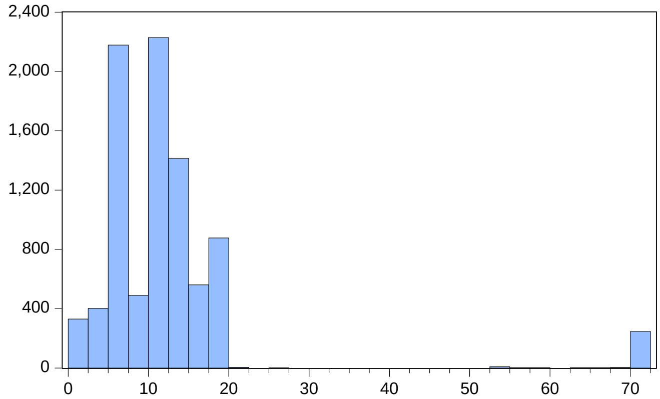
Series: ZONAL_PRICE_CN	
Sample 1 52567	
Observations 8760	
Mean	61.06503
Median	60.77000
Maximum	159.4000
Minimum	0.000000
Std. Dev.	15.37415
Skewness	0.510753
Kurtosis	5.022551
Jarque-Bera	1873.979
Probability	0.000000



Series: LOAD_CN	
Sample 1 52567	
Observations 8760	
Mean	3658.030
Median	3550.000
Maximum	6084.000
Minimum	1154.000
Std. Dev.	876.7545
Skewness	0.164515
Kurtosis	1.889638
Jarque-Bera	489.5252
Probability	0.000000

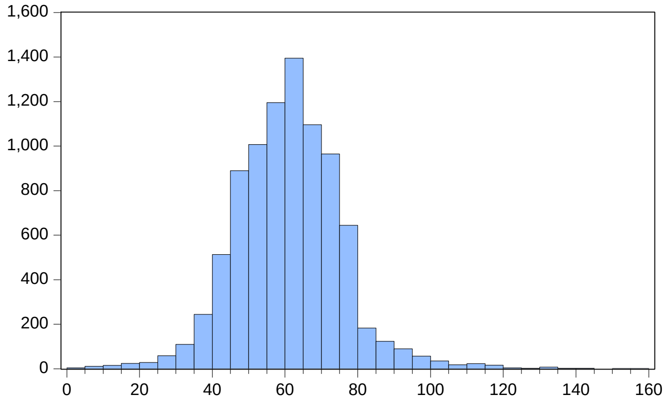


Series: SOLAR_CN	
Sample 1 52567	
Observations 8751	
Mean	250.0208
Median	6.000000
Maximum	1257.000
Minimum	0.000000
Std. Dev.	357.7658
Skewness	1.205467
Kurtosis	3.032586
Jarque-Bera	2119.808
Probability	0.000000

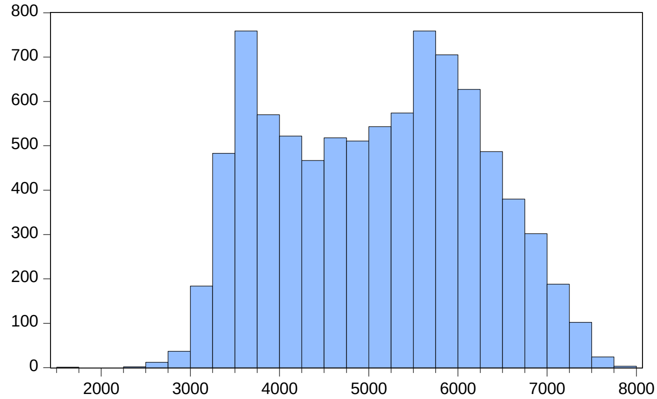


Series: WIND_CN	
Sample 1 52567	
Observations 8751	
Mean	12.20626
Median	11.00000
Maximum	72.00000
Minimum	0.000000
Std. Dev.	11.35590
Skewness	4.125594
Kurtosis	22.05165
Jarque-Bera	157170.6
Probability	0.000000

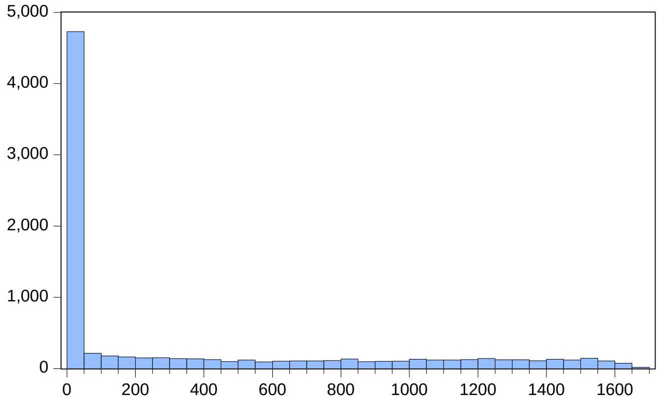
CENTRAL SOUTH



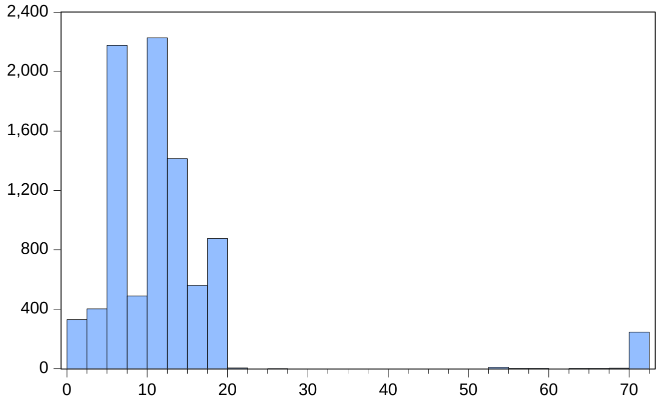
Series: PRICE_CS	
Sample 1 8761	
Observations 8760	
Mean	60.94138
Median	61.00000
Maximum	159.4000
Minimum	0.000000
Std. Dev.	14.54757
Skewness	0.374041
Kurtosis	5.446743
Jarque-Bera	2389.355
Probability	0.000000



Series: LOAD_CS	
Sample 1 8761	
Observations 8760	
Mean	5081.478
Median	5149.000
Maximum	7885.000
Minimum	1563.000
Std. Dev.	1131.698
Skewness	0.018173
Kurtosis	1.967089
Jarque-Bera	389.9028
Probability	0.000000

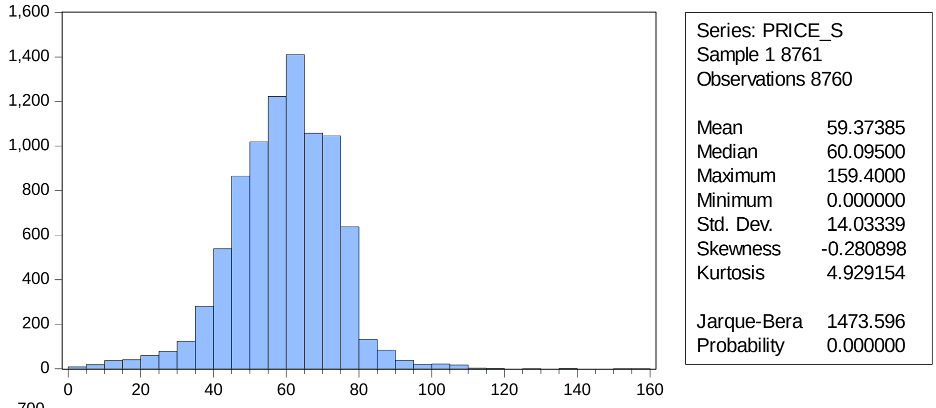


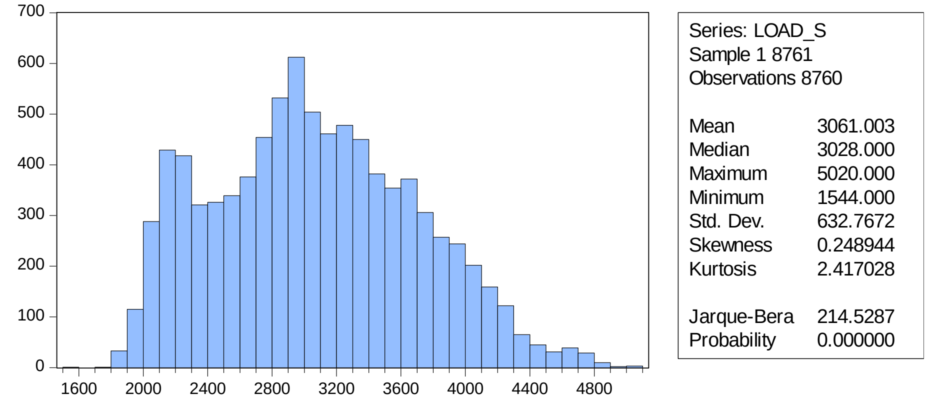
Series: SOLAR_CS	
Sample 1 8761	
Observations 8751	
Mean	370.4645
Median	9.000000
Maximum	1698.000
Minimum	0.000000
Std. Dev.	516.5444
Skewness	1.106443
Kurtosis	2.728020
Jarque-Bera	1812.491
Probability	0.000000

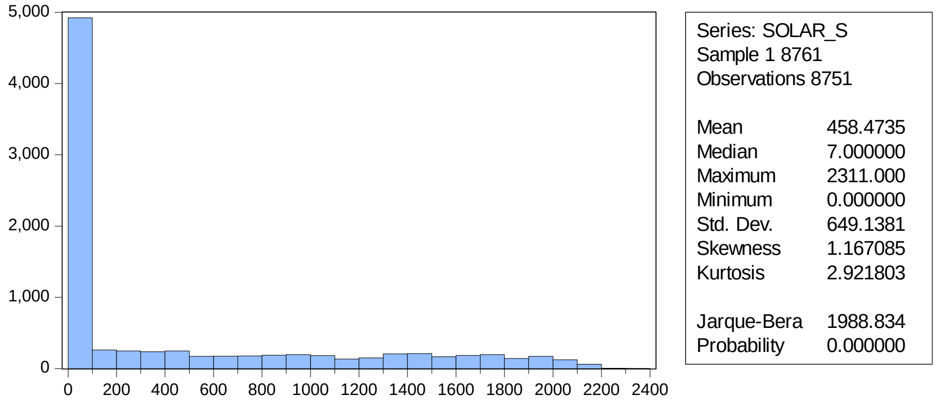


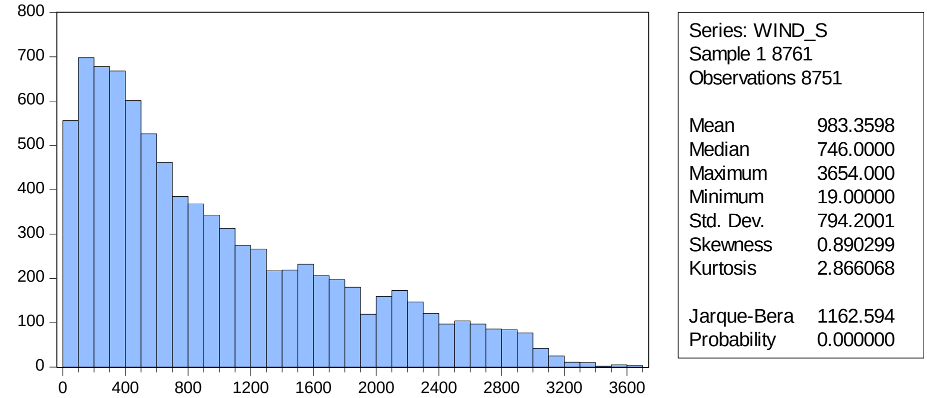
Series: WIND_CS	
Sample 1 8761	
Observations 8751	
Mean	12.20626
Median	11.00000
Maximum	72.00000
Minimum	0.000000
Std. Dev.	11.35590
Skewness	4.125594
Kurtosis	22.05165
Jarque-Bera	157170.6
Probability	0.000000

SOUTH

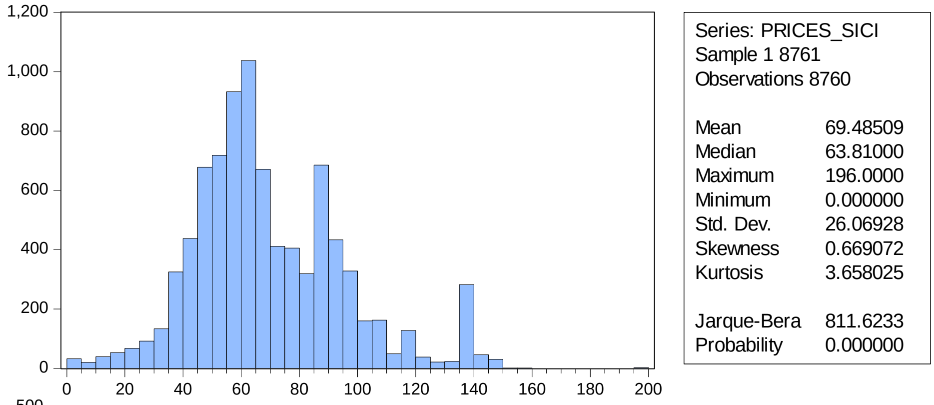

Series: PRICE_S
Sample 1 8761
Observations 8760
Mean 59.37385
Median 60.09500
Maximum 159.4000
Minimum 0.000000
Std. Dev. 14.03339
Skewness -0.280898
Kurtosis 4.929154
Jarque-Bera 1473.596
Probability 0.000000


Series: LOAD_S
Sample 1 8761
Observations 8760
Mean 3061.003
Median 3028.000
Maximum 5020.000
Minimum 1544.000
Std. Dev. 632.7672
Skewness 0.248944
Kurtosis 2.417028
Jarque-Bera 214.5287
Probability 0.000000


Series: SOLAR_S
Sample 1 8761
Observations 8751
Mean 458.4735
Median 7.000000
Maximum 2311.000
Minimum 0.000000
Std. Dev. 649.1381
Skewness 1.167085
Kurtosis 2.921803
Jarque-Bera 1988.834
Probability 0.000000


Series: WIND_S
Sample 1 8761
Observations 8751
Mean 983.3598
Median 746.0000
Maximum 3654.000
Minimum 19.00000
Std. Dev. 794.2001
Skewness 0.890299
Kurtosis 2.866068
Jarque-Bera 1162.594
Probability 0.000000

SICILY


Series: PRICES_SICI
Sample 1 8761
Observations 8760
Mean 69.48509
Median 63.81000
Maximum 196.0000
Minimum 0.000000
Std. Dev. 26.06928
Skewness 0.669072
Kurtosis 3.658025
Jarque-Bera 811.6233
Probability 0.000000
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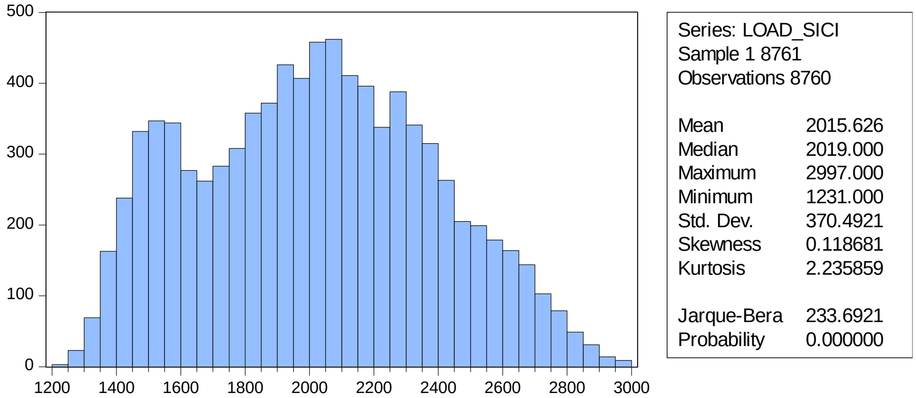
1,000
800
600
400
200
0
0 20 40 60 80 100 120 140 160 180 200


Series: LOAD_SICI
Sample 1 8761
Observations 8760
Mean 2015.626
Median 2019.000
Maximum 2997.000
Minimum 1231.000
Std. Dev. 370.4921
Skewness 0.118681
Kurtosis 2.235859
Jarque-Bera 233.6921
Probability 0.000000
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300
200
100
0
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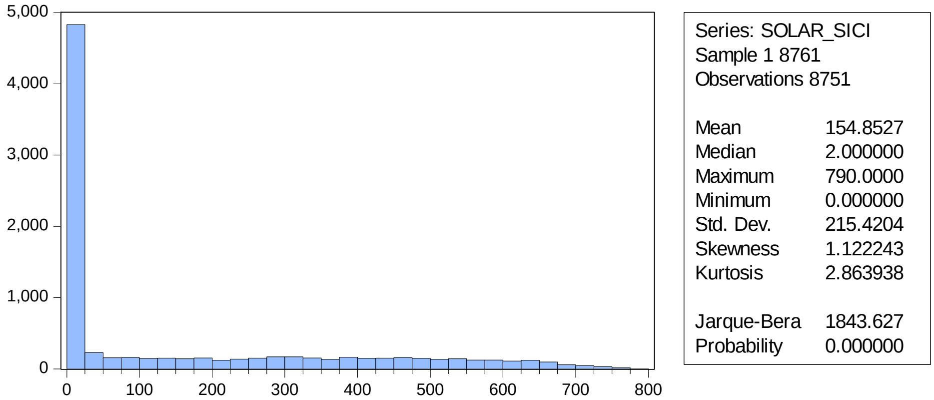
Series: SOLAR_SICI
Sample 1 8761
Observations 8751
Mean 154.8527
Median 2.000000
Maximum 790.0000
Minimum 0.000000
Std. Dev. 215.4204
Skewness 1.122243
Kurtosis 2.863938
Jarque-Bera 1843.627
Probability 0.000000
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4,000
3,000
2,000
1,000
0
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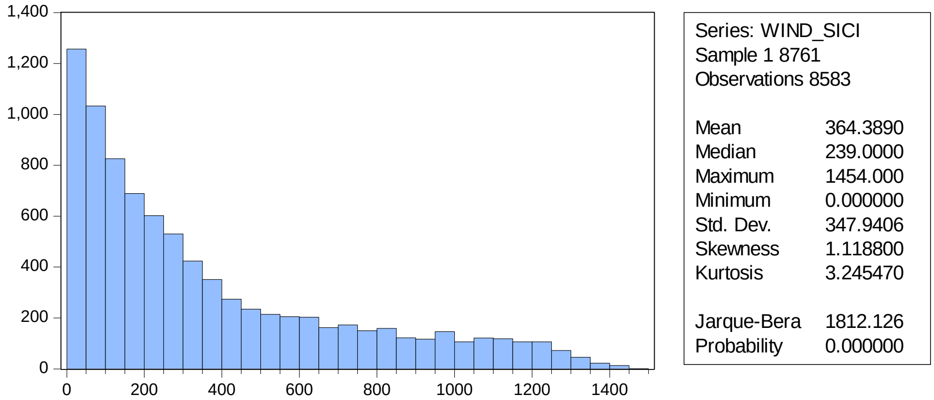
Series: WIND_SICI
Sample 1 8761
Observations 8583
Mean 364.3890
Median 239.0000
Maximum 1454.000
Minimum 0.000000
Std. Dev. 347.9406
Skewness 1.118800
Kurtosis 3.245470
Jarque-Bera 1812.126
Probability 0.000000
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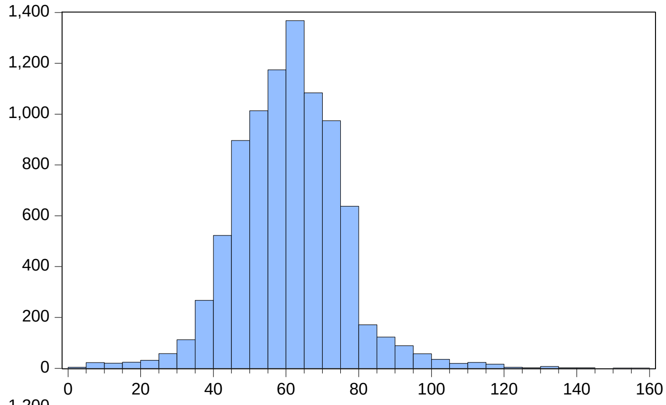
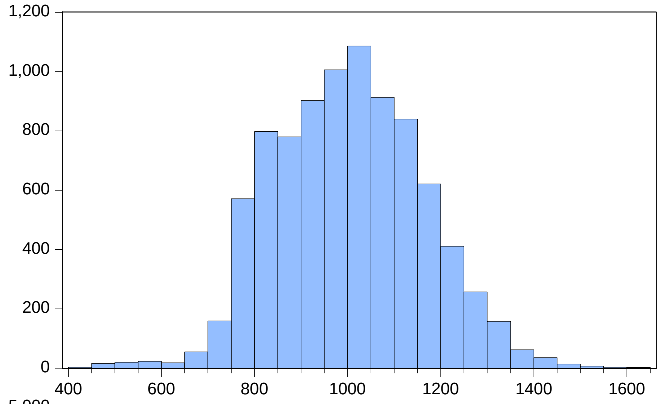
1,200
1,000
800
600
400
200
0
0 200 400 600 800 1000 1200 1400

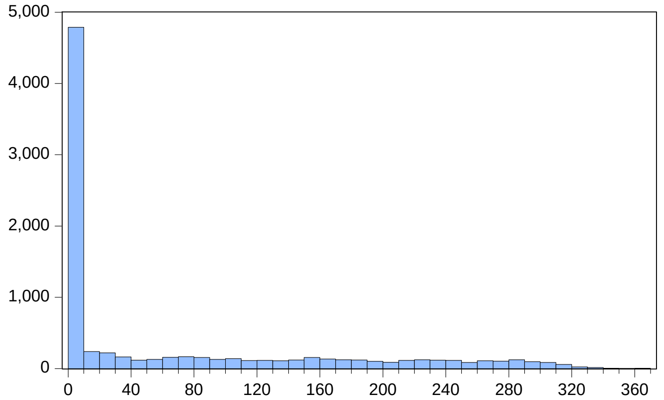
SARDINIA



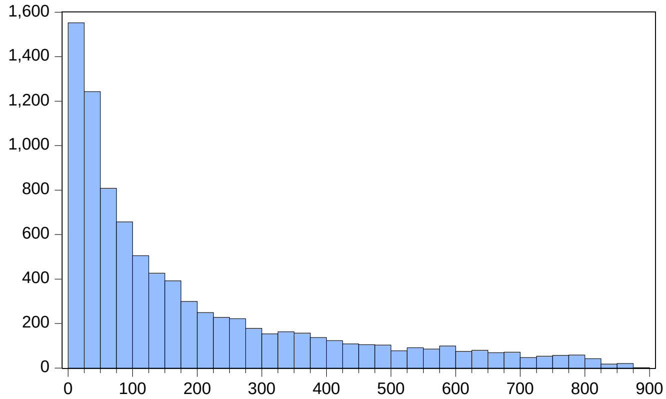
Series: PRICE_SARD	
Sample 1 8761	
Observations 8760	
Mean	60.69270
Median	60.86000
Maximum	159.4000
Minimum	0.000000
Std. Dev.	14.81151
Skewness	0.289604
Kurtosis	5.468942
Jarque-Bera	2347.372
Probability	0.000000



Series: LOAD_SARD	
Sample 1 8761	
Observations 8760	
Mean	1001.707
Median	1001.000
Maximum	1626.000
Minimum	420.0000
Std. Dev.	158.7719
Skewness	0.092706
Kurtosis	3.008039
Jarque-Bera	12.57149
Probability	0.001863



Series: SOLAR_SARD	
Sample 1 8761	
Observations 8751	
Mean	66.88516
Median	0.000000
Maximum	365.0000
Minimum	0.000000
Std. Dev.	95.68289
Skewness	1.216816
Kurtosis	3.107909
Jarque-Bera	2163.762
Probability	0.000000



Series: WIND_SARD	
Sample 1 8761	
Observations 8751	
Mean	187.9118
Median	105.0000
Maximum	876.0000
Minimum	3.000000
Std. Dev.	203.3453
Skewness	1.390110
Kurtosis	4.069231
Jarque-Bera	3235.272
Probability	0.000000

SPEARMAN TEST

NORTH

Covariance Analysis: Spearman rank-order
Sample: 2 8762
Included observations: 8741

Correlation Probability	LOAD_NORD	SOLAR_NORD	WIND_NORD
LOAD_NORD	1.000000 -----		
SOLAR_NORD	0.412661 0.0000	1.000000 -----	
WIND_NORD	-0.045402 0.0000	-0.036089 0.0007	1.000000 -----

CENTRAL NORTH

Covariance Analysis: Spearman rank-order
Sample: 1 8761
Included observations: 8751

Correlation Probability	LOAD_CN	SOLAR_CN	WIND_CN
LOAD_CN	1.000000 -----		
SOLAR_CN	0.467794 0.0000	1.000000 -----	
WIND_CN	-0.062166 0.0000	-0.061032 0.0000	1.000000 -----

CENTRAL SOUTH

Covariance Analysis: Spearman rank-order
Sample: 1 8761
Included observations: 8751

Correlation Probability	LOAD_CS	SOLAR_CS	WIND_CS
LOAD_CS	1.000000 -----		
SOLAR_CS	0.440071 0.0000	1.000000 -----	
WIND_CS	-0.017766 0.0966	-0.058564 0.0000	1.000000 -----

SOUTH

Covariance Analysis: Spearman rank-order
Sample: 1 8761
Included observations: 8751

Correlation Probability	LOAD_S	SOLAR_S	WIND_S
LOAD_S	1.000000 -----		
SOLAR_S	0.244213 0.0000	1.000000 -----	
WIND_S	-0.034186 0.0014	-0.070333 0.0000	1.000000 -----

SICILY

Covariance Analysis: Spearman rank-order
Sample: 1 8761
Included observations: 8583

Correlation Probability	LOAD_SICI	SOLAR_SICI	WIND_SICI
LOAD_SICI	1.000000 -----		
SOLAR_SICI	0.254453 0.0000	1.000000 -----	
WIND_SICI	-0.002765 0.7979	-0.016927 0.1169	1.000000 -----

SARDINIA

Covariance Analysis: Spearman rank-order
Sample: 1 8761
Included observations: 8751

Correlation Probability	LOAD_SARD	SOLAR_SARD	WIND_SARD
LOAD_SARD	1.000000 -----		
SOLAR_SARD	0.190675 0.0000	1.000000 -----	
WIND_SARD	-0.154739 0.0000	-0.007637 0.4750	1.000000 -----

UNIT ROOT TEST

NORTH

UNIT ROOT TEST RESULTS TABLE (ADF)

Null Hypothesis: the variable has a unit root

	At Level	PRICE	LOAD	SOLAR	WIND
With Constant	t-Statistic	-6.8505	-12.4357	-5.6430	-4.4144
	Prob.	***0.0000***	***0.0000***	***0.0000***	***0.0003***
		***	***	***	***

UNIT ROOT TEST RESULTS TABLE (PP)

Null Hypothesis: the variable has a unit root

	At Level	PRICE	LOAD	SOLAR	WIND
With Constant	t-Statistic	-34.0723	-8.5766	-14.5764	-6.7524
	Prob.	***0.0000***	***0.0000***	***0.0000***	***0.0000***
		***	***	***	***

CENTRAL NORTH

UNIT ROOT TEST RESULTS TABLE (ADF)

Null Hypothesis: the variable has a unit root

	At Level	PRICE	LOAD	SOLAR	WIND
With Constant	t-Statistic	-6.1926	-11.5836	-6.4603	-1.8819
	Prob.	***0.0000***	***0.0000***	***0.0000***	***0.3412***
		***	***	***	n0

UNIT ROOT TEST RESULTS TABLE (PP)

Null Hypothesis: the variable has a unit root

	At Level	PRICE	LOAD	SOLAR	WIND
With Constant	t-Statistic	-34.2498	-9.3549	-13.4059	-5.2146
	Prob.	***0.0000***	***0.0000***	***0.0000***	***0.0000***
		***	***	***	***

CENTRAL SOUTH

UNIT ROOT TEST RESULTS TABLE (ADF)

Null Hypothesis: the variable has a unit root

	At Level	PRICE_CS	LOAD_CS	SOLAR_CS	WIND_CS
With Constant	t-Statistic	-6.2341	-8.9224	-6.6834	-1.8819
	Prob.	***0.0000***	***0.0000***	***0.0000***	***0.3412***
		***	***	***	n0

UNIT ROOT TEST RESULTS TABLE (PP)

Null Hypothesis: the variable has a unit root

	At Level	PRICE_CS	LOAD_CS	SOLAR_CS	WIND_CS
With Constant	t-Statistic	-37.6794	-12.3796	-12.2401	-5.2146
	Prob.	***0.0000***	***0.0000***	***0.0000***	***0.0000***
		***	***	***	***

SOUTH

UNIT ROOT TEST RESULTS TABLE (ADF)
Null Hypothesis: the variable has a unit root

	At Level	PRICE	LOAD	SOLAR	WIND
With Constant	t-Statistic	-6.8038	-5.4969	-6.9610	-10.3796
	Prob.	***0.0000***	***0.0000***	***0.0000***	***0.0000***
		***	***	***	***

UNIT ROOT TEST RESULTS TABLE (PP)
Null Hypothesis: the variable has a unit root

	At Level	PRICE	LOAD	SOLAR	WIND
With Constant	t-Statistic	-50.9559	-46.6500	-12.7784	-11.7219
	Prob.	***0.0001***	***0.0001***	***0.0000***	***0.0000***
		***	***	***	***

SICILY

UNIT ROOT TEST RESULTS TABLE (ADF)
Null Hypothesis: the variable has a unit root

	At Level	PRICES	LOAD	SOLAR	WIND
With Constant	t-Statistic	-7.6596	-6.5251	-7.4649	-9.1859
	Prob.	***0.0000***	***0.0000***	***0.0000***	***0.0000***
		***	***	***	***

UNIT ROOT TEST RESULTS TABLE (PP)
Null Hypothesis: the variable has a unit root

	At Level	PRICES	LOAD	SOLAR	WIND
With Constant	t-Statistic	-53.3341	-23.8180	-12.5881	-9.9123
	Prob.	***0.0001***	***0.0000***	***0.0000***	***0.0000***
		***	***	***	***

SARDINIA

UNIT ROOT TEST RESULTS TABLE (ADF)
Null Hypothesis: the variable has a unit root

	At Level	PRICE	LOAD	SOLAR	WIND
With Constant	t-Statistic	-6.3395	-7.5795	-7.5350	-9.8133
	Prob.	***0.0000***	***0.0000***	***0.0000***	***0.0000***
		***	***	***	***

UNIT ROOT TEST RESULTS TABLE (PP)
Null Hypothesis: the variable has a unit root

	At Level	PRICE	LOAD	SOLAR	WIND
With Constant	t-Statistic	-39.3399	-26.0833	-12.9517	-10.3652
	Prob.	***0.0000***	***0.0000***	***0.0000***	***0.0000***
		***	***	***	***

RESULTS

NORTH

Dependent Variable: ZONAL_PRICE_NORD
Method: ARMA Conditional Least Squares (Gauss-Newton / Marquardt steps)
Sample (adjusted): 3 8762
Included observations: 8735 after adjustments
Convergence achieved after 11 iterations
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	10.09599	2.173163	4.645758	0.0000
LOAD_NORD	0.002725	7.36E-05	37.03467	0.0000
SOLAR_NORD	-0.001725	0.000248	-6.955691	0.0000
WIND_NORD	0.005353	0.023902	0.223971	0.8228
HOUR_NORD=2	-1.571384	0.171975	-9.137256	0.0000
HOUR_NORD=3	-2.943233	0.222039	-13.25547	0.0000
HOUR_NORD=4	-4.094670	0.264132	-15.50237	0.0000
HOUR_NORD=5	-4.271369	0.292409	-14.60750	0.0000
HOUR_NORD=6	-3.341323	0.331487	-10.07980	0.0000
HOUR_NORD=7	-2.502617	0.430841	-5.808673	0.0000
HOUR_NORD=8	-4.208703	0.559389	-7.523750	0.0000
HOUR_NORD=9	-4.075397	0.669689	-6.085507	0.0000
HOUR_NORD=10	-6.030962	0.773502	-7.796952	0.0000
HOUR_NORD=11	-7.631033	0.867599	-8.795579	0.0000
HOUR_NORD=12	-8.356626	0.940824	-8.882241	0.0000
HOUR_NORD=13	-8.015050	0.928636	-8.630994	0.0000
HOUR_NORD=14	-9.464338	0.949577	-9.966895	0.0000
HOUR_NORD=15	-9.674886	0.910321	-10.62799	0.0000
HOUR_NORD=16	-8.540324	0.837619	-10.19595	0.0000
HOUR_NORD=17	-7.022742	0.779806	-9.005761	0.0000
HOUR_NORD=18	-5.640031	0.712719	-7.913402	0.0000
HOUR_NORD=19	-3.902747	0.668000	-5.842438	0.0000
HOUR_NORD=20	-1.241654	0.614516	-2.020538	0.0434
HOUR_NORD=21	-2.649987	0.522184	-5.074811	0.0000
HOUR_NORD=22	-4.225012	0.447171	-9.448308	0.0000
HOUR_NORD=23	-2.814784	0.344800	-8.163521	0.0000
HOUR_NORD=24	-2.848093	0.272067	-10.46835	0.0000
DAY_NORD=2	-1.789709	2.087545	-0.857328	0.3913
DAY_NORD=3	-2.639113	2.012914	-1.311090	0.1899
DAY_NORD=4	-4.200769	2.061516	-2.037709	0.0416
DAY_NORD=5	-4.555092	1.937083	-2.351522	0.0187
DAY_NORD=6	-3.347802	2.040252	-1.640876	0.1009
DAY_NORD=7	-4.405949	1.917265	-2.298038	0.0216
DAY_NORD=8	-4.637287	1.865730	-2.485508	0.0130
DAY_NORD=9	-4.418295	1.822158	-2.424759	0.0153
DAY_NORD=10	-3.389482	1.880016	-1.802901	0.0714
DAY_NORD=11	-2.868283	1.946510	-1.473552	0.1406
DAY_NORD=12	-3.418203	1.843835	-1.853855	0.0638
DAY_NORD=13	-1.411767	1.783035	-0.791778	0.4285
DAY_NORD=14	-2.090824	1.797226	-1.163361	0.2447
DAY_NORD=15	-0.920266	1.763435	-0.521859	0.6018
DAY_NORD=16	-2.212951	1.786811	-1.238492	0.2156
DAY_NORD=17	-2.693742	1.874970	-1.436685	0.1508
DAY_NORD=18	-4.232636	1.808574	-2.340317	0.0193
DAY_NORD=19	-4.182127	1.847285	-2.263932	0.0236
DAY_NORD=20	-1.866980	1.873369	-0.996589	0.3190
DAY_NORD=21	0.145233	1.932967	0.075135	0.9401
DAY_NORD=22	1.245538	1.989575	0.626032	0.5313
DAY_NORD=23	-0.411082	1.885181	-0.218060	0.8274
DAY_NORD=24	0.542239	1.826316	0.296903	0.7665
DAY_NORD=25	0.061891	1.782316	0.034725	0.9723

DAY_NORD=26	-0.004047	1.835288	-0.002205	0.9982
DAY_NORD=27	0.421775	1.828442	0.230675	0.8176
DAY_NORD=28	-2.413367	1.672403	-1.443053	0.1490
DAY_NORD=29	-1.883009	1.595717	-1.180040	0.2380
DAY_NORD=30	-1.396594	1.367390	-1.021357	0.3071
DAY_NORD=31	-0.063276	1.281815	-0.049364	0.9606
MONTH_NORD="Aug"	16.40715	1.620765	10.12309	0.0000
MONTH_NORD="Dec"	12.19699	1.941075	6.283623	0.0000
MONTH_NORD="Feb"	-2.054783	1.981277	-1.037100	0.2997
MONTH_NORD="Jan"	-6.460021	1.834290	-3.521809	0.0004
MONTH_NORD="July"	1.782845	1.738172	1.025701	0.3051
MONTH_NORD="June"	0.334623	2.050661	0.163178	0.8704
MONTH_NORD="Mar"	2.343196	1.986448	1.179591	0.2382
MONTH_NORD="May"	0.538996	1.690274	0.318881	0.7498
MONTH_NORD="Nov."	11.20839	1.987918	5.638255	0.0000
MONTH_NORD="Oct."	20.13752	2.024538	9.946725	0.0000
MONTH_NORD="Sept"	22.01689	2.085463	10.55732	0.0000
AR(1)	0.894257	0.013132	68.09759	0.0000

R-squared	0.931260	Mean dependent var	60.66602
Adjusted R-squared	0.930720	S.D. dependent var	15.38596
S.E. of regression	4.049745	Akaike info criterion	5.643053
Sum squared resid	142126.2	Schwarz criterion	5.698941
Log likelihood	-24577.03	Hannan-Quinn criter.	5.662099
F-statistic	1726.509	Durbin-Watson stat	1.773551
Prob(F-statistic)	0.000000		

Inverted AR Roots	.89

CENTRAL NORTH

Dependent Variable: ZONAL_PRICE_CN
Method: ARMA Conditional Least Squares (Gauss-Newton / Marquardt steps)
Sample (adjusted): 2 8761
Included observations: 8748 after adjustments
Convergence achieved after 8 iterations
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	13.16686	2.282228	5.769301	0.0000
LOAD_CN	0.013158	0.000417	31.57568	0.0000
SOLAR_CN	-0.010796	0.000703	-15.34866	0.0000
WIND_CN	-0.008621	0.022346	-0.385804	0.6997
HOUR=2	-1.500503	0.224593	-6.681003	0.0000
HOUR=3	-3.119333	0.294127	-10.60541	0.0000
HOUR=4	-4.224847	0.346548	-12.19122	0.0000
HOUR=5	-4.136171	0.365734	-11.30923	0.0000
HOUR=6	-2.703186	0.399726	-6.762595	0.0000
HOUR=7	-0.918619	0.459807	-1.997834	0.0458
HOUR=8	-1.345217	0.564916	-2.381270	0.0173
HOUR=9	-0.597562	0.703975	-0.848841	0.3960
HOUR=10	-2.313488	0.818413	-2.826797	0.0047
HOUR=11	-4.020344	0.885065	-4.542429	0.0000
HOUR=12	-4.615142	0.911142	-5.065226	0.0000
HOUR=13	-5.302960	0.882195	-6.011098	0.0000
HOUR=14	-5.472425	0.869121	-6.296506	0.0000
HOUR=15	-6.047698	0.840743	-7.193281	0.0000
HOUR=16	-5.789903	0.815352	-7.101112	0.0000
HOUR=17	-5.306558	0.793695	-6.685895	0.0000
HOUR=18	-4.818543	0.768556	-6.269607	0.0000
HOUR=19	-3.502223	0.738662	-4.741306	0.0000
HOUR=20	-0.940024	0.720929	-1.303907	0.1923
HOUR=21	-1.622471	0.623105	-2.603849	0.0092

HOUR=22	-3.714733	0.533492	-6.963055	0.0000
HOUR=23	-3.407496	0.409429	-8.322551	0.0000
HOUR=24	-4.002817	0.302544	-13.23051	0.0000
DAY=2	-0.767010	1.796144	-0.427032	0.6694
DAY=3	-2.329912	1.763620	-1.321096	0.1865
DAY=4	-2.910094	1.845839	-1.576570	0.1149
DAY=5	-3.582322	1.797286	-1.993184	0.0463
DAY=6	-2.392641	1.892945	-1.263978	0.2063
DAY=7	-5.152514	1.840502	-2.799516	0.0051
DAY=8	-5.169388	1.801456	-2.869560	0.0041
DAY=9	-3.500234	1.842286	-1.899941	0.0575
DAY=10	-2.087236	1.775079	-1.175856	0.2397
DAY=11	-2.619982	1.765522	-1.483970	0.1379
DAY=12	-3.841015	1.764147	-2.177265	0.0295
DAY=13	-2.553909	1.752547	-1.457255	0.1451
DAY=14	-3.309799	1.755354	-1.885545	0.0594
DAY=15	-1.722569	1.712016	-1.006164	0.3144
DAY=16	-3.365214	1.756918	-1.915407	0.0555
DAY=17	-2.618407	1.852655	-1.413327	0.1576
DAY=18	-3.908233	1.795219	-2.177023	0.0295
DAY=19	-3.365347	1.978184	-1.701230	0.0889
DAY=20	-1.638286	1.853305	-0.883981	0.3767
DAY=21	0.528939	1.935731	0.273250	0.7847
DAY=22	0.843851	1.995519	0.422873	0.6724
DAY=23	-0.319055	1.907173	-0.167292	0.8671
DAY=24	0.178973	1.799569	0.099453	0.9208
DAY=25	-0.800831	1.822019	-0.439530	0.6603
DAY=26	0.430974	1.939082	0.222257	0.8241
DAY=27	1.075449	1.850071	0.581302	0.5611
DAY=28	-1.194823	1.770405	-0.674887	0.4998
DAY=29	-2.370453	1.785430	-1.327665	0.1843
DAY=30	-1.776079	1.736658	-1.022699	0.3065
DAY=31	-1.305660	1.492030	-0.875089	0.3815
MONTH="Aug"	17.12996	1.499591	11.42308	0.0000
MONTH="Dec"	11.53695	1.784189	6.466212	0.0000
MONTH="Feb"	-0.985331	1.811711	-0.543868	0.5865
MONTH="Jan"	-5.833141	1.599807	-3.646152	0.0003
MONTH="July"	5.447984	1.719661	3.168058	0.0015
MONTH="June"	3.769242	1.791024	2.104518	0.0354
MONTH="Mar"	0.404926	1.821595	0.222292	0.8241
MONTH="May"	3.318994	1.676940	1.979197	0.0478
MONTH="Nov."	12.18469	1.775498	6.862689	0.0000
MONTH="Oct."	21.93811	1.754263	12.50559	0.0000
MONTH="Sept"	24.87067	1.885664	13.18934	0.0000
AR(1)	0.865039	0.010155	85.18207	0.0000

R-squared	0.921190	Mean dependent var	61.05062
Adjusted R-squared	0.920572	S.D. dependent var	15.36435
S.E. of regression	4.330126	Akaike info criterion	5.776926
Sum squared resid	162731.1	Schwarz criterion	5.832743
Log likelihood	-25199.28	Hannan-Quinn criter.	5.795946
F-statistic	1491.856	Durbin-Watson stat	1.876124
Prob(F-statistic)	0.000000		

Inverted AR Roots	.87

CENTRAL SOUTH

Dependent Variable: PRICE_CS
Method: ARMA Conditional Least Squares (Gauss-Newton / Marquardt steps)
Sample (adjusted): 2 8761
Included observations: 8748 after adjustments
Convergence achieved after 8 iterations
Coefficient covariance computed using outer product of gradients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	10.13831	1.935712	5.237509	0.0000
LOAD_CS	0.011172	0.000277	40.28256	0.0000
SOLAR_CS	-0.009139	0.000481	-18.98628	0.0000
WIND_CS	-0.037059	0.022633	-1.637394	0.1016
HOUR=2	0.102933	0.254100	0.405090	0.6854
HOUR=3	-0.488418	0.356480	-1.370114	0.1707
HOUR=4	-1.176101	0.418282	-2.811739	0.0049
HOUR=5	-1.309903	0.456809	-2.867505	0.0041
HOUR=6	-0.289557	0.474398	-0.610368	0.5416
HOUR=7	0.654478	0.481883	1.358170	0.1744
HOUR=8	-0.481811	0.527778	-0.912905	0.3613
HOUR=9	-0.343866	0.624608	-0.550530	0.5820
HOUR=10	-3.856457	0.728329	-5.294939	0.0000
HOUR=11	-6.186002	0.786862	-7.861608	0.0000
HOUR=12	-7.754642	0.817612	-9.484505	0.0000
HOUR=13	-10.08534	0.828066	-12.17939	0.0000
HOUR=14	-10.25078	0.804073	-12.74858	0.0000
HOUR=15	-10.28543	0.775837	-13.25721	0.0000
HOUR=16	-9.691558	0.737938	-13.13330	0.0000
HOUR=17	-8.823630	0.700977	-12.58762	0.0000
HOUR=18	-8.498203	0.692725	-12.26778	0.0000
HOUR=19	-8.278427	0.690949	-11.98123	0.0000
HOUR=20	-6.853513	0.708721	-9.670250	0.0000
HOUR=21	-8.715675	0.673688	-12.93727	0.0000
HOUR=22	-9.694046	0.572269	-16.93966	0.0000
HOUR=23	-8.510252	0.435839	-19.52614	0.0000
HOUR=24	-7.123281	0.276739	-25.74008	0.0000
DAY=2	-0.300251	1.110484	-0.270378	0.7869
DAY=3	-1.988742	1.366072	-1.455810	0.1455
DAY=4	-2.586195	1.480355	-1.747010	0.0807
DAY=5	-3.511865	1.535442	-2.287201	0.0222
DAY=6	-3.263762	1.563084	-2.088027	0.0368
DAY=7	-4.112922	1.577123	-2.607864	0.0091
DAY=8	-5.100466	1.583956	-3.220081	0.0013
DAY=9	-4.340652	1.587807	-2.733741	0.0063
DAY=10	-3.514197	1.590319	-2.209744	0.0271
DAY=11	-3.131070	1.591119	-1.967841	0.0491
DAY=12	-3.543953	1.592105	-2.225954	0.0260
DAY=13	-3.192424	1.592961	-2.004082	0.0451
DAY=14	-3.421726	1.592400	-2.148785	0.0317
DAY=15	-2.454624	1.592870	-1.541007	0.1234
DAY=16	-4.121820	1.594464	-2.585083	0.0098
DAY=17	-4.513990	1.601653	-2.818332	0.0048
DAY=18	-4.401996	1.604226	-2.743999	0.0061
DAY=19	-2.986406	1.597111	-1.869880	0.0615
DAY=20	-1.547687	1.594489	-0.970647	0.3318
DAY=21	-0.907819	1.591855	-0.570290	0.5685
DAY=22	0.582505	1.590068	0.366339	0.7141
DAY=23	-0.694072	1.588152	-0.437031	0.6621
DAY=24	0.718255	1.584799	0.453215	0.6504
DAY=25	-0.427281	1.579113	-0.270583	0.7867
DAY=26	1.524493	1.564088	0.974685	0.3297
DAY=27	0.113477	1.535869	0.073884	0.9411
DAY=28	-0.834754	1.474158	-0.566258	0.5712

DAY=29	-2.379991	1.450492	-1.640816	0.1009
DAY=30	-1.824420	1.307182	-1.395690	0.1628
DAY=31	-2.792835	1.377260	-2.027819	0.0426
MONTH="Aug"	15.19509	1.666575	9.117555	0.0000
MONTH="Dec"	7.934283	1.780176	4.457021	0.0000
MONTH="Feb"	-6.324744	1.715966	-3.685821	0.0002
MONTH="Jan"	-10.30935	1.709734	-6.029800	0.0000
MONTH="July"	4.300701	1.682305	2.556434	0.0106
MONTH="June"	6.821465	1.668688	4.087921	0.0000
MONTH="Mar"	-2.250798	1.624948	-1.385150	0.1660
MONTH="May"	1.357582	1.614952	0.840633	0.4006
MONTH="Nov."	9.205641	1.679371	5.481601	0.0000
MONTH="Oct."	16.75934	1.669973	10.03570	0.0000
MONTH="Sept"	21.76071	1.670848	13.02375	0.0000
AR(1)	0.870831	0.005297	164.3888	0.0000

R-squared	0.910755	Mean dependent var	60.92680
Adjusted R-squared	0.910055	S.D. dependent var	14.53592
S.E. of regression	4.359438	Akaike info criterion	5.790420
Sum squared resid	164941.8	Schwarz criterion	5.846236
Log likelihood	-25258.30	Hannan-Quinn criter.	5.809440
F-statistic	1302.494	Durbin-Watson stat	1.924608
Prob(F-statistic)	0.000000		

Inverted AR Roots	.87

SOUTH

Dependent Variable: PRICE_S
Method: ARMA Conditional Least Squares (Gauss-Newton / Marquardt steps)
Sample (adjusted): 2 8761
Included observations: 8748 after adjustments
Convergence achieved after 7 iterations
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	26.14137	3.035080	8.613076	0.0000
LOAD_S	0.010793	0.000866	12.46833	0.0000
SOLAR_S	-0.005981	0.000461	-12.97938	0.0000
WIND_S	-0.002029	0.000347	-5.852177	0.0000
HOUR=1	4.647696	0.411858	11.28471	0.0000
HOUR=2	2.819365	0.557439	5.057709	0.0000
HOUR=3	0.760328	0.640402	1.187268	0.2352
HOUR=4	-0.257487	0.644739	-0.399367	0.6896
HOUR=5	-0.420001	0.637409	-0.658918	0.5100
HOUR=6	1.598935	0.609251	2.624429	0.0087
HOUR=7	5.411456	0.550524	9.829642	0.0000
HOUR=8	7.917661	0.511501	15.47928	0.0000
HOUR=9	9.458281	0.631621	14.97462	0.0000
HOUR=10	7.752537	0.727204	10.66074	0.0000
HOUR=11	5.711407	0.784310	7.282082	0.0000
HOUR=12	3.683751	0.808938	4.553813	0.0000
HOUR=13	1.506487	0.798518	1.886603	0.0592
HOUR=14	0.400433	0.758958	0.527608	0.5978
HOUR=15	0.848105	0.698070	1.214929	0.2244
HOUR=16	1.921636	0.621711	3.090883	0.0020
HOUR=17	3.346778	0.589408	5.678198	0.0000
HOUR=18	4.014421	0.643538	6.238053	0.0000
HOUR=19	4.727577	0.702273	6.731822	0.0000
HOUR=20	6.588027	0.759917	8.669401	0.0000
HOUR=21	4.582565	0.764029	5.997890	0.0000
HOUR=22	2.416934	0.576723	4.190806	0.0000
HOUR=23	1.508501	0.310722	4.854824	0.0000

DAY=2	0.469779	2.140211	0.219501	0.8263
DAY=3	-0.837938	2.004671	-0.417993	0.6760
DAY=4	-0.759492	2.081853	-0.364815	0.7153
DAY=5	-2.165858	2.062942	-1.049888	0.2938
DAY=6	-1.756541	2.206087	-0.796225	0.4259
DAY=7	-1.798823	2.209768	-0.814033	0.4156
DAY=8	-3.123841	2.077718	-1.503496	0.1327
DAY=9	-2.761935	2.096640	-1.317315	0.1878
DAY=10	-1.527129	2.021875	-0.755303	0.4501
DAY=11	-1.100578	2.031974	-0.541630	0.5881
DAY=12	-1.445718	2.041057	-0.708319	0.4788
DAY=13	-0.988109	2.081603	-0.474686	0.6350
DAY=14	-2.136075	2.220923	-0.961796	0.3362
DAY=15	-1.212802	2.070081	-0.585872	0.5580
DAY=16	-2.552616	2.030332	-1.257241	0.2087
DAY=17	-2.902400	2.137491	-1.357854	0.1745
DAY=18	-2.452142	2.277984	-1.076453	0.2818
DAY=19	-1.645972	2.268628	-0.725536	0.4681
DAY=20	0.028399	2.220403	0.012790	0.9898
DAY=21	0.156236	2.207241	0.070784	0.9436
DAY=22	0.699983	2.253865	0.310570	0.7561
DAY=23	-0.386844	2.112292	-0.183140	0.8547
DAY=24	0.287554	2.084467	0.137951	0.8903
DAY=25	-1.431410	2.161770	-0.662147	0.5079
DAY=26	-0.333122	2.315333	-0.143877	0.8856
DAY=27	-1.833247	2.227173	-0.823127	0.4105
DAY=28	-2.569364	2.144159	-1.198308	0.2308
DAY=29	-5.185108	2.221014	-2.334568	0.0196
DAY=30	-1.820480	2.232955	-0.815278	0.4149
DAY=31	-3.271717	2.433375	-1.344519	0.1788
MONTH="Aug"	3.465388	2.092083	1.656430	0.0977
MONTH="Dec"	6.269248	1.837860	3.411167	0.0006
MONTH="Feb"	-2.530846	2.066720	-1.224571	0.2208
MONTH="Jan"	-7.473930	1.878565	-3.978531	0.0001
MONTH="July"	1.881818	2.147992	0.876083	0.3810
MONTH="June"	3.420157	2.313928	1.478075	0.1394
MONTH="Mar"	-0.905381	1.878347	-0.482009	0.6298
MONTH="May"	1.357722	2.071438	0.655449	0.5122
MONTH="Nov."	6.479032	1.743480	3.716149	0.0002
MONTH="Oct."	13.13879	2.093539	6.275876	0.0000
MONTH="Sept"	11.25828	2.279097	4.939797	0.0000
AR(1)	0.870792	0.009469	91.95932	0.0000

R-squared	0.902322	Mean dependent var	59.38036
Adjusted R-squared	0.901557	S.D. dependent var	14.03346
S.E. of regression	4.403088	Akaike info criterion	5.810346
Sum squared resid	168261.4	Schwarz criterion	5.866162
Log likelihood	-25345.45	Hannan-Quinn criter.	5.829366
F-statistic	1179.035	Durbin-Watson stat	1.839705
Prob(F-statistic)	0.000000		

Inverted AR Roots	.87

SICILY

Dependent Variable: PRICES_SICI
Method: ARMA Conditional Least Squares (Gauss-Newton / Marquardt steps)
Sample (adjusted): 2 8761
Included observations: 8541 after adjustments
Convergence achieved after 7 iterations
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.552319	3.629138	-0.152190	0.8790
LOAD_SICI	0.035987	0.001551	23.19903	0.0000
SOLAR_SICI	-0.033433	0.002205	-15.15904	0.0000
WIND_SICI	-0.015257	0.001179	-12.94138	0.0000
HOUR=2	-2.846577	0.554497	-5.133619	0.0000
HOUR=3	-4.379303	0.698851	-6.266437	0.0000
HOUR=4	-4.998638	0.764118	-6.541711	0.0000
HOUR=5	-5.072197	0.807344	-6.282572	0.0000
HOUR=6	-3.913954	0.836664	-4.678047	0.0000
HOUR=7	-1.107568	0.865411	-1.279818	0.2006
HOUR=8	3.167625	1.000817	3.165039	0.0016
HOUR=9	7.413926	1.263751	5.866602	0.0000
HOUR=10	4.694742	1.396248	3.362398	0.0008
HOUR=11	1.010609	1.500699	0.673425	0.5007
HOUR=12	-1.683335	1.526478	-1.102758	0.2702
HOUR=13	-3.443265	1.509431	-2.281167	0.0226
HOUR=14	-3.811902	1.456218	-2.617672	0.0089
HOUR=15	-2.769916	1.384797	-2.000232	0.0455
HOUR=16	-1.404037	1.325942	-1.058898	0.2897
HOUR=17	-0.495857	1.321302	-0.375279	0.7075
HOUR=18	2.771228	1.334108	2.077214	0.0378
HOUR=19	6.080184	1.413678	4.300967	0.0000
HOUR=20	9.082351	1.495484	6.073186	0.0000
HOUR=21	9.359828	1.499171	6.243337	0.0000
HOUR=22	8.714653	1.330754	6.548657	0.0000
HOUR=23	6.102916	1.076723	5.668044	0.0000
HOUR=24	1.272685	0.787301	1.616517	0.1060
DAY=2	1.287677	2.531438	0.508674	0.6110
DAY=3	2.218975	3.195258	0.694459	0.4874
DAY=4	3.877105	3.038778	1.275876	0.2020
DAY=5	6.437014	2.955741	2.177801	0.0294
DAY=6	4.753174	3.010322	1.578959	0.1144
DAY=7	3.700449	2.919263	1.267597	0.2050
DAY=8	2.795555	3.217696	0.868806	0.3850
DAY=9	2.209703	3.228628	0.684409	0.4937
DAY=10	4.857433	3.289265	1.476753	0.1398
DAY=11	1.657717	3.265081	0.507711	0.6117
DAY=12	1.843192	3.118902	0.590975	0.5546
DAY=13	-1.707169	3.154748	-0.541143	0.5884
DAY=14	0.504931	3.068520	0.164552	0.8693
DAY=15	-0.109689	3.051163	-0.035950	0.9713
DAY=16	-0.650626	3.122678	-0.208355	0.8350
DAY=17	1.342745	3.256629	0.412311	0.6801
DAY=18	3.550630	3.756489	0.945199	0.3446
DAY=19	0.271669	4.030461	0.067404	0.9463
DAY=20	0.654330	3.580443	0.182751	0.8550
DAY=21	-4.521678	3.335597	-1.355583	0.1753
DAY=22	-2.570000	3.405106	-0.754749	0.4504
DAY=23	-1.484133	3.475217	-0.427062	0.6693
DAY=24	-2.343267	3.450446	-0.679120	0.4971
DAY=25	-2.766266	3.196945	-0.865284	0.3869
DAY=26	-1.636772	3.504207	-0.467088	0.6404
DAY=27	-1.442644	3.559382	-0.405307	0.6853
DAY=28	-0.634795	3.820705	-0.166146	0.8680

DAY=29	-2.682420	3.623369	-0.740311	0.4591
DAY=30	-4.862708	2.983868	-1.629666	0.1032
DAY=31	0.292280	3.682568	0.079369	0.9367
MONTH="Aug"	23.71228	2.752317	8.615388	0.0000
MONTH="Dec"	14.80433	2.370774	6.244512	0.0000
MONTH="Feb"	-5.498238	2.490024	-2.208106	0.0273
MONTH="Jan"	0.479736	2.559287	0.187449	0.8513
MONTH="July"	8.151247	2.827845	2.882494	0.0040
MONTH="June"	4.602047	2.127768	2.162851	0.0306
MONTH="Mar"	-3.469393	2.021693	-1.716083	0.0862
MONTH="May"	6.017339	2.066675	2.911604	0.0036
MONTH="Nov."	10.85085	1.926935	5.631145	0.0000
MONTH="Oct."	9.987168	1.886106	5.295126	0.0000
MONTH="Sept"	9.009195	2.614558	3.445782	0.0006
AR(1)	0.819185	0.009113	89.89352	0.0000

R-squared	0.890152	Mean dependent var	69.21919
Adjusted R-squared	0.889271	S.D. dependent var	26.22575
S.E. of regression	8.726887	Akaike info criterion	7.178740
Sum squared resid	645215.3	Schwarz criterion	7.235716
Log likelihood	-30587.81	Hannan-Quinn criter.	7.198179
F-statistic	1009.602	Durbin-Watson stat	1.903662
Prob(F-statistic)	0.000000		

Inverted AR Roots	.82

SARDINIA

Dependent Variable: PRICE_SARD
Method: ARMA Conditional Least Squares (Gauss-Newton / Marquardt steps)
Sample (adjusted): 2 8761
Included observations: 8748 after adjustments
Convergence achieved after 5 iterations
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	24.39837	3.032290	8.046186	0.0000
LOAD_SARD	0.032708	0.002544	12.85499	0.0000
SOLAR_SARD	-0.029769	0.002734	-10.88878	0.0000
WIND_SARD	-0.003541	0.001418	-2.497189	0.0125
HOUR=2	-2.400611	0.265553	-9.040058	0.0000
HOUR=3	-4.448289	0.342684	-12.98074	0.0000
HOUR=4	-5.559592	0.385494	-14.42201	0.0000
HOUR=5	-5.673727	0.397989	-14.25599	0.0000
HOUR=6	-3.697021	0.421759	-8.765725	0.0000
HOUR=7	0.069445	0.477505	0.145433	0.8844
HOUR=8	1.976358	0.584335	3.382233	0.0007
HOUR=9	5.378880	0.735539	7.312837	0.0000
HOUR=10	4.616083	0.801494	5.759346	0.0000
HOUR=11	3.495805	0.844362	4.140172	0.0000
HOUR=12	2.561958	0.877075	2.921024	0.0035
HOUR=13	0.410527	0.890338	0.461091	0.6447
HOUR=14	-0.816025	0.854842	-0.954592	0.3398
HOUR=15	0.015349	0.815629	0.018818	0.9850
HOUR=16	1.616599	0.776606	2.081621	0.0374
HOUR=17	3.408884	0.746487	4.566567	0.0000
HOUR=18	4.362572	0.772110	5.650196	0.0000
HOUR=19	4.562481	0.821575	5.553334	0.0000
HOUR=20	6.240908	0.893576	6.984197	0.0000
HOUR=21	2.911382	0.902555	3.225713	0.0013
HOUR=22	-0.163992	0.760688	-0.215584	0.8293
HOUR=23	-1.742604	0.571351	-3.049971	0.0023
HOUR=24	-3.799284	0.402432	-9.440812	0.0000

DAY=2	-0.389178	2.546292	-0.152841	0.8785
DAY=3	-0.948175	2.217521	-0.427583	0.6690
DAY=4	-1.143478	2.205614	-0.518440	0.6042
DAY=5	-1.628671	2.090940	-0.778918	0.4360
DAY=6	-1.605603	2.188987	-0.733491	0.4633
DAY=7	-1.982943	2.126123	-0.932657	0.3510
DAY=8	-3.182147	2.080656	-1.529396	0.1262
DAY=9	-3.001758	2.071332	-1.449192	0.1473
DAY=10	-1.888792	2.104386	-0.897550	0.3695
DAY=11	-1.100398	2.088151	-0.526972	0.5982
DAY=12	-2.004404	2.109531	-0.950166	0.3421
DAY=13	-1.673181	2.125178	-0.787314	0.4311
DAY=14	-1.953696	2.222743	-0.878957	0.3794
DAY=15	-1.460785	2.113739	-0.691090	0.4895
DAY=16	-1.699555	2.090219	-0.813099	0.4162
DAY=17	-2.858940	2.242783	-1.274729	0.2024
DAY=18	-1.536776	2.315190	-0.663780	0.5068
DAY=19	0.967345	2.355924	0.410601	0.6814
DAY=20	1.128304	2.344427	0.481270	0.6303
DAY=21	0.376765	2.314384	0.162793	0.8707
DAY=22	2.485522	2.335246	1.064351	0.2872
DAY=23	0.955109	2.228797	0.428531	0.6683
DAY=24	1.979090	2.214353	0.893756	0.3715
DAY=25	0.361527	2.230013	0.162119	0.8712
DAY=26	1.880814	2.331875	0.806567	0.4199
DAY=27	0.433289	2.197561	0.197168	0.8437
DAY=28	0.271885	2.074426	0.131065	0.8957
DAY=29	-1.753673	2.115465	-0.828977	0.4071
DAY=30	-1.453376	1.991636	-0.729740	0.4656
DAY=31	-1.594409	1.851067	-0.861346	0.3891
MONTH="Aug"	8.909996	1.872004	4.759603	0.0000
MONTH="Dec"	9.044490	1.865362	4.848652	0.0000
MONTH="Feb"	-1.455296	1.984535	-0.733319	0.4634
MONTH="Jan"	-6.645071	1.813288	-3.664652	0.0002
MONTH="July"	6.223319	1.840368	3.381563	0.0007
MONTH="June"	4.743189	1.969402	2.408441	0.0160
MONTH="Mar"	3.423427	1.902079	1.799835	0.0719
MONTH="May"	1.573080	1.908931	0.824063	0.4099
MONTH="Nov."	11.55460	1.918537	6.022608	0.0000
MONTH="Oct."	19.06181	1.984185	9.606873	0.0000
MONTH="Sept"	19.67111	2.187660	8.991846	0.0000
AR(1)	0.867890	0.010005	86.74681	0.0000

R-squared	0.896696	Mean dependent var	60.67778
Adjusted R-squared	0.895887	S.D. dependent var	14.80018
S.E. of regression	4.775511	Akaike info criterion	5.972735
Sum squared resid	197929.0	Schwarz criterion	6.028552
Log likelihood	-26055.74	Hannan-Quinn criter.	5.991755
F-statistic	1107.873	Durbin-Watson stat	1.840756
Prob(F-statistic)	0.000000		

Inverted AR Roots	.87

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